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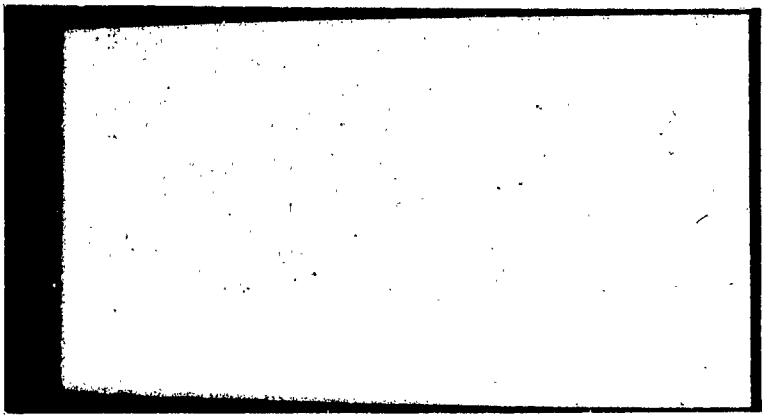

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DATE 10 January 1963

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ELECTRICAL POTTING COMPOUNDS - SURFACE AND VOLUME RESISTIVITY AT ELEVATED TEMPERATURES FOR PROTRACTED TIMES (PHASE II: ELECTRICAL TESTS)

REPORT 9354 SERIAL NO. 18

MCDONNELL AIRCRAFT CORPORATION

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Final Report

LABORATORY: Electrical-Instrumentation

ELECTRICAL POTTING COMPOUNDS - SURFACE AND VOLUME RESISTIVITY AT ELEVATED TEMPERATURES FOR PROTRACTED TIMES

ABSTRACT

Four electrical potting compounds, Product Research PR-1525, Pro Seal 777, GE RTV-60 and 3M EC-1663 were tested to determine their suitability for use for protracted times at elevated temperatures.

Volume and surface resistivity specimens and connector specimens were fabricated and subjected to physical and electrical tests. Physical test results are contained in progress report number 1; electrical test results are contained herein.

After exposure to 300°F for 300 hours the volume and surface resistivity specimens of Proseal 777 and PR-1525 had charred and reverted to a resinous material accompanied by great deterioration of electrical characteristics. These materials are unsuitable for use in applications between sheets or plates similar to the test setup.

The Proseal 777 and PR-1525 materials did not revert when tested at 300°F for 300 hours as potting in Bendix connectors and they exhibited electrical characteristics equal to or better than the unpotted control sample connectors. These materials may be used for extended times at 300°F in this and similar applications.

After exposure to 500°F for 1000 hours the EC-1663 and RTV-60 specimens exhibited slight changes of hardness and electrical characteristics. Both of these materials are suitable for use at 500°F, however, RTV-60 is somewhat superior to EC-1663.

Prepared by _____ Approved by _____
Test Engineer Senior Engineer, Lab.

Approved by _____ Approved by _____
Chief, Elec. - Instr. Lab. Laboratory Project Engineer

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1. INTRODUCTION

Results are presented for electrical testing of potting compound specimens at elevated temperatures for protracted times. This report completes testing requested by MAC TR 513-246.

Testing was conducted on several commercial potting compounds with various curing methods to determine their suitability for protracted use at elevated temperatures.

Specimen preparation and physical testing was done by the System Laboratory (Dept. 252) and is described in progress report number 1, TR 513-246.

Electrical testing was conducted during the period of 24 August 1961 through 17 March 1962 by the Electrical and Instrumentation Laboratory (Dept. 255), General Engineering Division, McDonnell Aircraft.

2. DESCRIPTION OF TEST ARTICLE

Four potting materials were tested: Product Research PR 1525, Pro-Seal 777, General Electric RTV-60 and 3M EC1663.

Volume and surface resistivity specimens 4.0 inches in diameter and approximately 0.125 inch thick were prepared from each material using various curing methods as outlined in Table 1, page 6 .

Electrical connector samples were potted with each material using various primers and cures as outlined in Table 2, page 8 . Unpotted connectors were also prepared for use as control samples.

Details of specimen preparation are contained in Progress Report 1.

3. TEST SETUP AND PROCEDURE

Two sets of specimens were prepared. One set was subjected to a life test during which electrical resistance measurements were made at regular intervals while maintaining the specimens at elevated temperature. The other set of specimens was subjected to a variable temperature test during which the specimen temperature was increased in regular increments with electrical resistance measurements made at each temperature after allowing one hour for thermal stabilization.

Both volume and surface resistivity were measured on the 4 inch diameter specimens as detailed in Tables 3 and 4, page 9 . A measurement method detailed in part 9 of 1958 ASTM standard D257-58 was used. This method consisted of placing the sample on a conducting plate and placing a concentric conducting ring and disk on top of the sample.

3. TEST SETUP AND PROCEDURE (CONT'D)

Volume resistance measurement was made by measuring through the specimen from disk to plate with a megohmmeter. Surface resistance was measured across the gap between the ring and the disk. See Figure 1, page 5.

The specimens were tested in an oven in groups of six. Meter connections were made through a port in the top of the oven. Heavy teflon sleeving was pulled over each lead wire to reduce external leakage resistance. See photo, page 74.

For the potted connector samples, pin to pin and pin to shell resistances were measured as detailed in Tables 5 and 6, page 10. The connectors under test together with a control sample were placed in an oven. Teflon insulated lead wires were used for minimum leakage.

4. TEST RESULTS

All volume and surface resistance meter readings were recorded in megohms and later converted to volume resistivity and surface resistance by application of formulas shown in Figure 1.

Potted connector pin to pin and pin to shell resistances were recorded directly in megohms.

All data was plotted on graphs and is presented on pages 11 through 73.

5. DISCUSSION OF TEST RESULTS

During exposure to 300°F for 300 hours the center areas of the Proseal 777 and PR-1525 volume and surface resistivity specimens charred and reverted to a resinous material accompanied by deterioration of electrical characteristics. All reverting occured in the center area of the specimens with no evidence of reverting around the edges. The Proseal 777 and PR-1525 samples used to Pot Bendix connectors did not revert when subjected to the same conditions of 300°F for 300 hours. Electrical characteristics of the Potted Bendix connector samples were no worse than the unpotted control samples indicating that the temperature capabilities of the Neoprene connector inserts are the limiting factor in extended 300°F use.

Difficulty was encountered with tests of the EC-1663 and RTV-60 potted connector samples due to the low leakage resistance of the Bendix piggy connectors as indicated by measurements of the unpotted control samples. The connector resistance formed an upper limit above which potting resistance could not be measured. Better results were obtained with the Cannon connectors as their leakage resistance was much higher.

The EC-1663 and RTV-60 specimens withstood 300°F for 1000 hours with little physical or electrical deterioration.

6. CONCLUSIONS

Test results indicate that because of reversion, the Proseal 777 and PR-1525 polyurethane materials are not suitable for extended 300°F use when contained between sheets or plates as in the volume and surface resistivity setup. However, results indicate that the Proseal 777 and PR-1525 will not revert during extended 300°F exposure when used for connector potting and that their electrical characteristics equal or exceed the Neoprene connector inserts.

Test results indicate that the EC 1663 and RTV-60 silicone rubber materials are suitable for extended use at 500°F, however, RTV-60 is somewhat superior to EC-1663.

LIST OF EQUIPMENT AND INSTRUMENTS

Equipment and instruments used in this test are listed below. Applicable calibration records are available for inspection.

Item	Manufacturer and Model Number	Serial Number
Air circulating Oven	New England Oven and Furnace Co.	1189
Resistance Meter	SIE	R-1770
Potentiometer Pyrometer	Thermo-Electric Co.	K-3872-4

REFERENCES

TR 513-246 Progress Report 1
ASTM D257-58
MAC P.S. 17172
MAC P.S. 17311

MAC 21-1 (Rev 11 Sep. 59)

Surface Resistivity

$$\sigma = \frac{\pi D_o}{D_2 - D_1} \cdot R \quad \text{Ohms}$$

Volume Resistivity

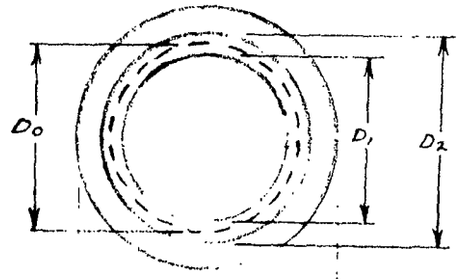
$$\rho = \frac{A}{t} \cdot R \quad \text{Ohm - CM}$$

R = Measured Resistance

t = Specimen Thickness

$$A = \frac{\pi D_o}{4}$$

$$D_o = \frac{D_1 + D_2}{2}$$



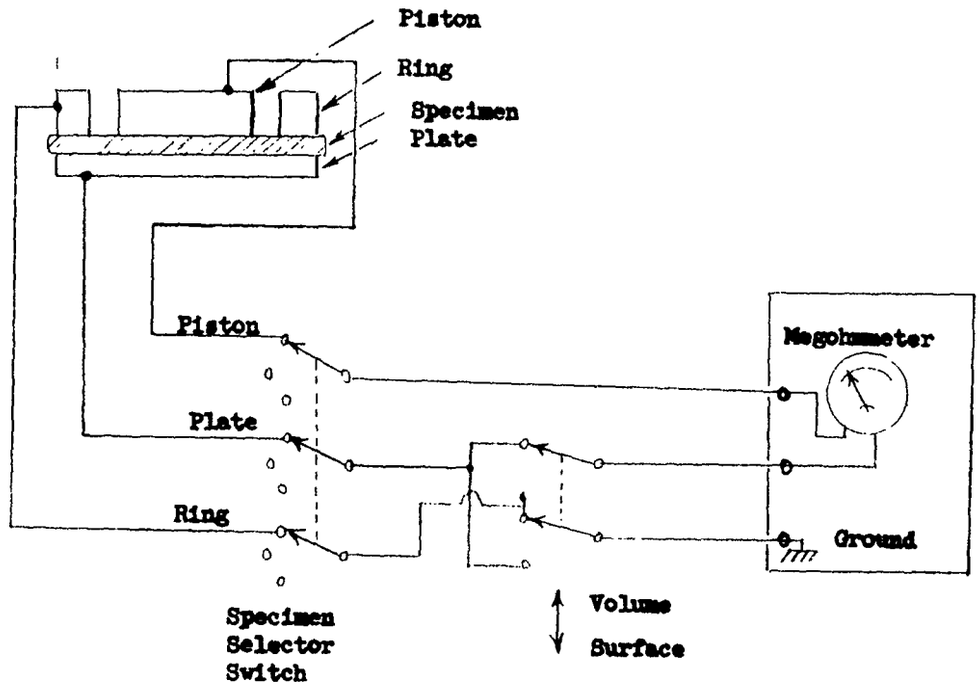


Figure 1

TABLE 1

Volume and Surface Resistivity Specimens

Material	No.	Thickness (in)	TR Paragraph	Cure
Proseal 777	1	0.128	5.1.1.1	Room temperature, 48 hours min.
	2	0.127		
	3	0.128		
	4	0.127		
	5	0.130		
	6	0.124		
Proseal 777	1	0.124	5.1.1.2	24 hours at room temperature
	2	0.122		followed by 4 hours at 180°F
	3	0.122		
	4	0.128		
	5	0.124		
	6	0.128		
Proseal 777	1	0.127	5.1.1.3	5 1/2 hours at 180°F
	2	0.128		
	3	0.127		
	4	0.126		
	5	0.126		
	6	0.126		
Proseal 777	1	0.123	5.1.1.4	5 1/2 hours at 220°F
	2	0.119		
	3	0.122		
	4	0.122		
	5	0.125		
	6	0.126		
PR 1525	1	0.140	5.1.2.1	72 Hours at room temperature
	2	0.134		
	3	0.141		
	4	0.135		
	5	0.123		
	6	0.124		
PR 1525	1	0.121	5.1.2.2	3 Hours at 180°F
	2	0.126		
	3	0.124		
	4	0.126		
	5	0.125		
	6	0.125		
PR 1525	1	0.125	5.1.2.3	16 Hours at 180°F
	2	0.124		
	3	0.123		
	4	0.125		
	5	0.128		
	6	0.125		

TABLE 1 (CONT'D)

Material	No.	Thickness (in)	TR Paragraph	Cure
EC1663	1	0.124	5.1.3	24 Hours at room temperature with
	2	0.124		50% minimum relative humidity
	3	0.125		followed by 10 hours at 180°F
	4	0.121		
	5	0.123		
	6	0.127		
RTV-60	1	0.125	5.1.4	24 Hours at room temperature with
	2	0.123		50% minimum relative humidity
	3	0.123		followed by 10 hours at 180°F
	4	0.125		
	5	0.123		
	6	0.127		

TABLE 2

Potted Connectors

Material	Connector	Primer	TR Paragraph	Cure
Proseal 777	Bendix PT	Proseal 777P	5.2.1	5 1/2 hours at 180°F
PR 1525	Bendix PT	PR 1521 & PR 1522	5.2.2	30 minutes at room temp. for each primer and 3 hrs at 180°F after potting.
EC 1663	Bendix PT	EC 1694	5.2.3(a)	2 hours at room temp. for primer pot per P.S. 17172
EC 1663	Bendix PT	EX-B579-1	5.2.3(b)	Primer per P.S. 17172 & air dry 2 hrs. Pot per P.S. 17172
RTV-60	Bendix PT	EX-B579-1	5.2.4(a)	Primer per P.S. 17311 clean & pot per P.S. 17172
RTV-60	Bendix PT	EC-1694	5.2.4(b)	Prime per P.S. 17172 & air dry for 2 hrs. pot per P.S. 17172
EC 1663	Cannon CA3106RR-10SL-45	EC-1694	5.3.1	Same as 5.2.3(a)
EC 1663	Cannon CA3106RR-10SL-45	EX-B579-1	5.3.2	Same as 5.2.3(b)
RTV-60	Cannon CA3106RR-10SL-45	EX-B579-1	5.3.3	Same as 5.2.4(a)
RTV-60	Cannon CA3106RR-10SL-45	EC-1694	5.3.4	Same as 5.2.4(b)

TABLE 3

Variable Temperature Test

Material	Cure	Number of Specimens	Test Temperatures °F
-TTT	5.1.1.1	3	R.T., 100, 150, 200, 250, 300 & 350
-TTT	5.1.1.2	3	
-TTT	5.1.1.3	3	
-TTT	5.1.1.4	3	
PR-1525	5.1.2.1	3	
PR-1525	5.1.2.2	3	
PR-1525	5.1.2.3	3	
EC-1663	5.1.3	3	R.T., 100, 200, 300, 400, 500, & 600
RTV-60	5.1.4	3	

TABLE 4

Life Test

Material	Cure	Number of Specimens	Test Temp.	Test Reading Times in Hours
-TTT	5.1.1.1	3	300°F	0.5, 1.0, 5.0, 10, 25, 50, 75, 100, 150, 200, 250 & 300
-TTT	5.1.1.2	3		
-TTT	5.1.1.3	3		
-TTT	5.1.1.4	3		
PR-1525	5.1.2.1	3		
PR-1525	5.1.2.2	3		
PR-1525	5.1.2.3	3		
EC-1663	5.1.3	3	500°F	0.5, 1.0, 5.0, 10, 25, 50, 75, 100, 150, 200, 250, 300, 350, 400, 450, 500, 550, 600, 650, 700, 750, 800, 850, 900, 950, & 1000
RTV-60	5.1.4	3		

TABLE 5

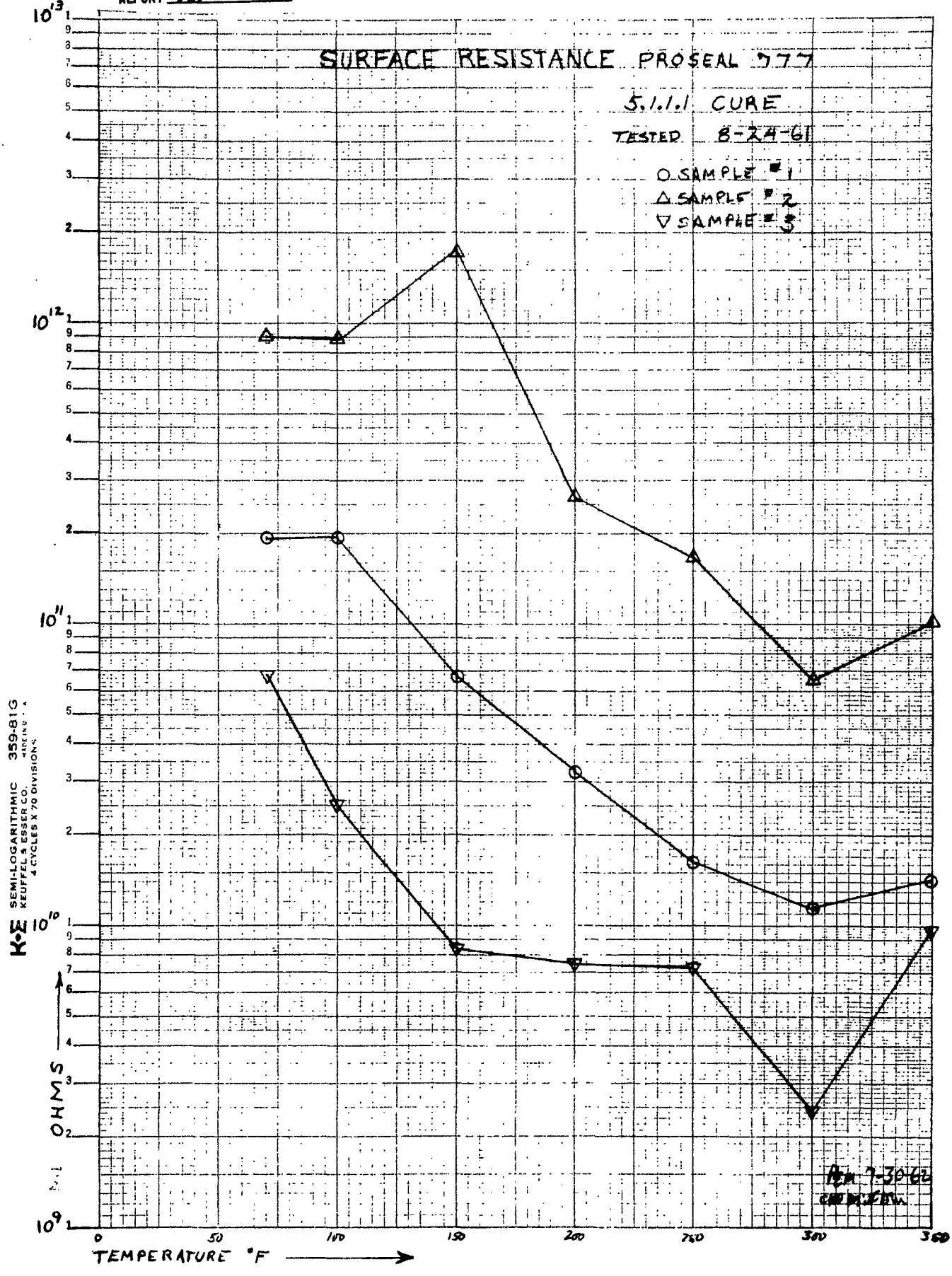
Variable Temperature Test

Material	Cure	No. of Specimens	Test Temperatures °F
-777	5.2.1	1	R.T., 100, 150, 200, 250, 300, & 350
PR-1525	5.2.2	1	
EC-1663	5.2.3(a)	1	
EC-1663	5.2.3(b)	1	
RTV-60	5.2.4(a)	1	
RTV-60	5.2.4(b)	1	

TABLE 6

Life Test

Material	Cure	Number of Specimens	Test Temp.	Test Reading Time in Hours
-777	5.2.1	1	300°F	0.5, 1.0, 5, 10, 25, 50, 75, 100, 150, 250, 250 & 300
PR-1525	5.2.2	1		
EC-1663	5.3.1	1	500°F	0.5, 1.0, 5, 10, 25, 50, 75, 100, 150, 200, 250, 300, 350, 400, 450, 500, 550, 600, 650, 700, 750, 800, 850, 900, 950, & 1000
EC-1663	5.3.2	1		
RTV-60	5.3.3	1		
RTV-60	5.3.4	1		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5.1.1.1 CURE
TESTED 8-24-61
○ SAMPLE # 1
△ SAMPLE # 2
▽ SAMPLE # 3
SEMI-LOGARITHMIC 359-81G
KEUFFEL & ESSER CO.
4 CYCLES X 70 DIVISIONS
K&E
OHMS
10^{13}
10^{12}
10^{11}
10^{10}
10^{9}
0
50
100
150
200
250
300
350
TEMPERATURE °F
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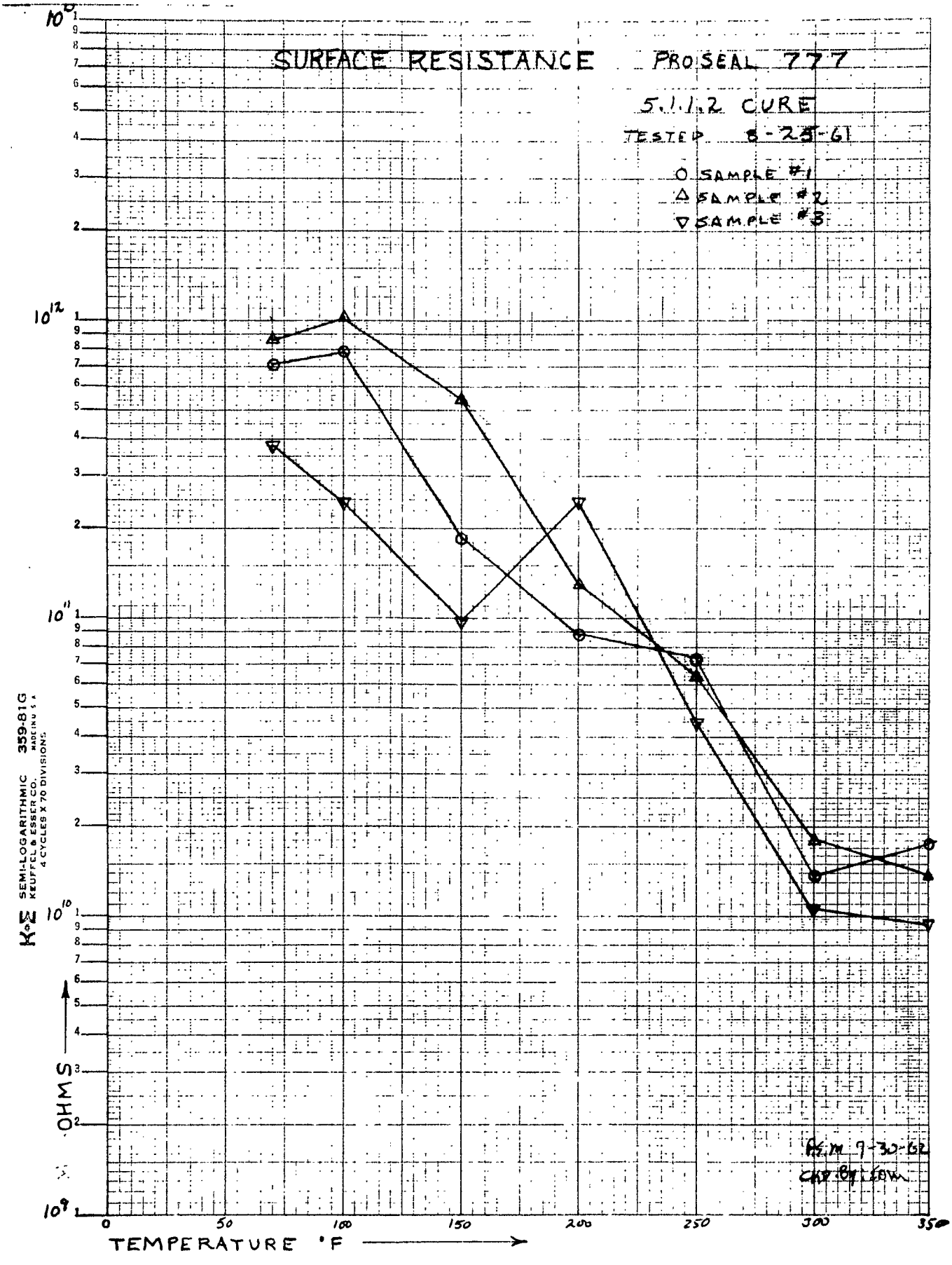
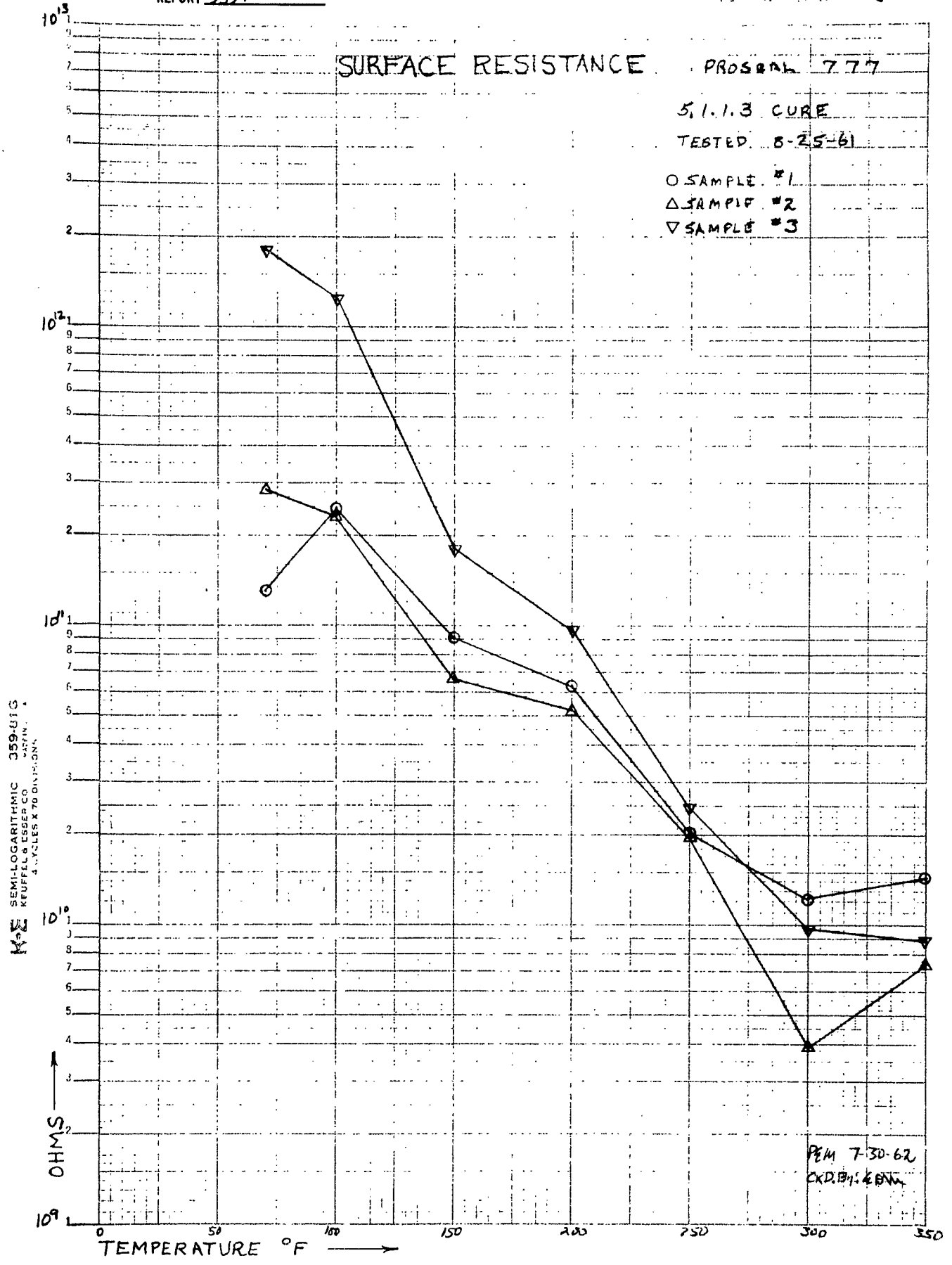
POTTING SAMPLES




SURFACE RESISTANCE
PROSEAL 777
5.1.1.3 CURE
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○ SAMPLE #1
△ SAMPLE #2
▽ SAMPLE #3
OHMS
TEMPERATURE °F
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50
100
150
200
250
300
350
PEM 7-30-62
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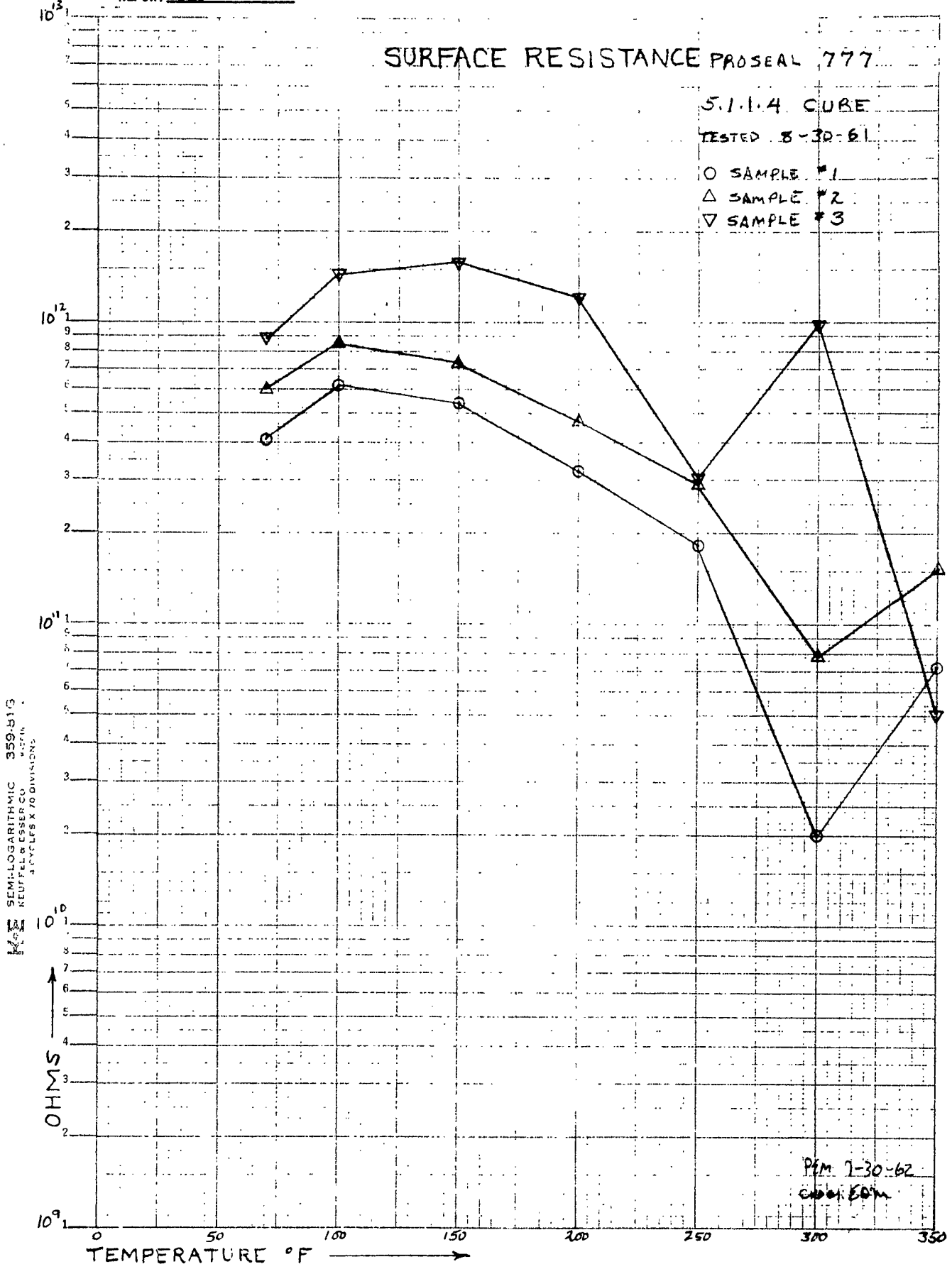
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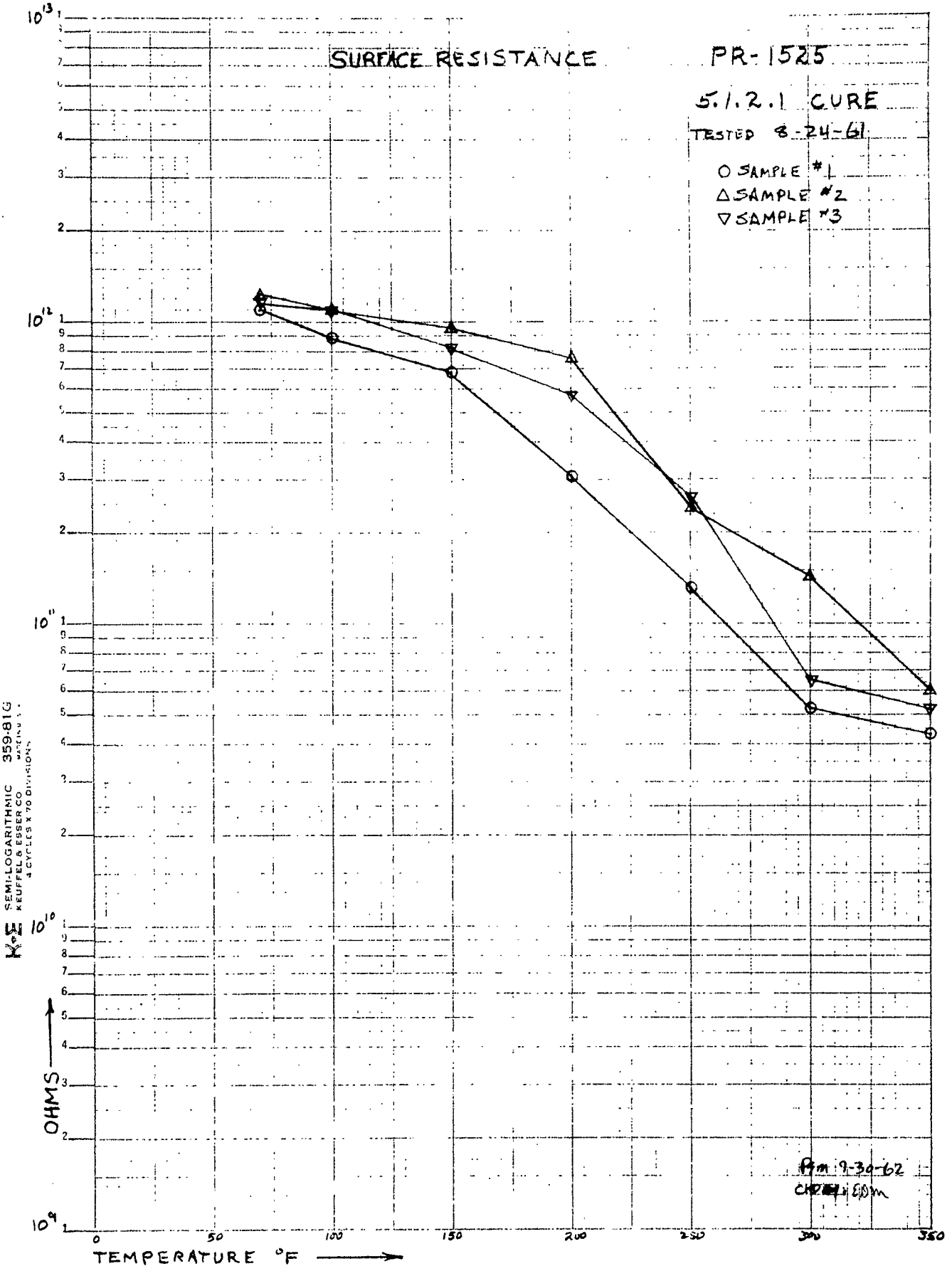
SEMI-LOGARITHMIC 359-81G
KEUFFEL & ESSER CO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PR-1525
5.1.2.1 CURE
TESTED 8-24-61
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△ SAMPLE #2
▽ SAMPLE #3
SEMI-LOGARITHMIC 359-81G
KEUFFEL & ESSER CO
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OHMS
TEMPERATURE °F
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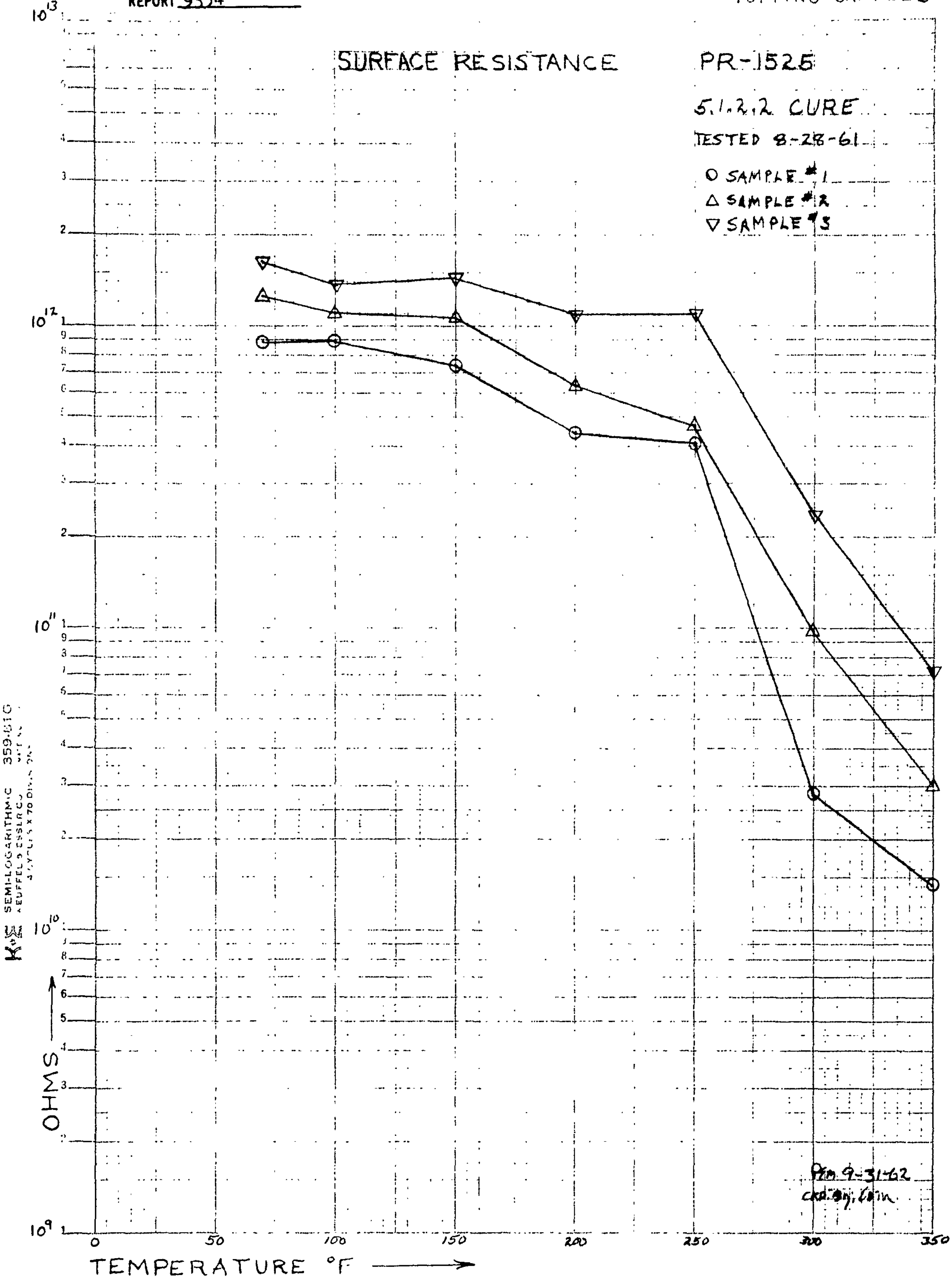
50
100
150
200
250
300
350
Pm 9-30-62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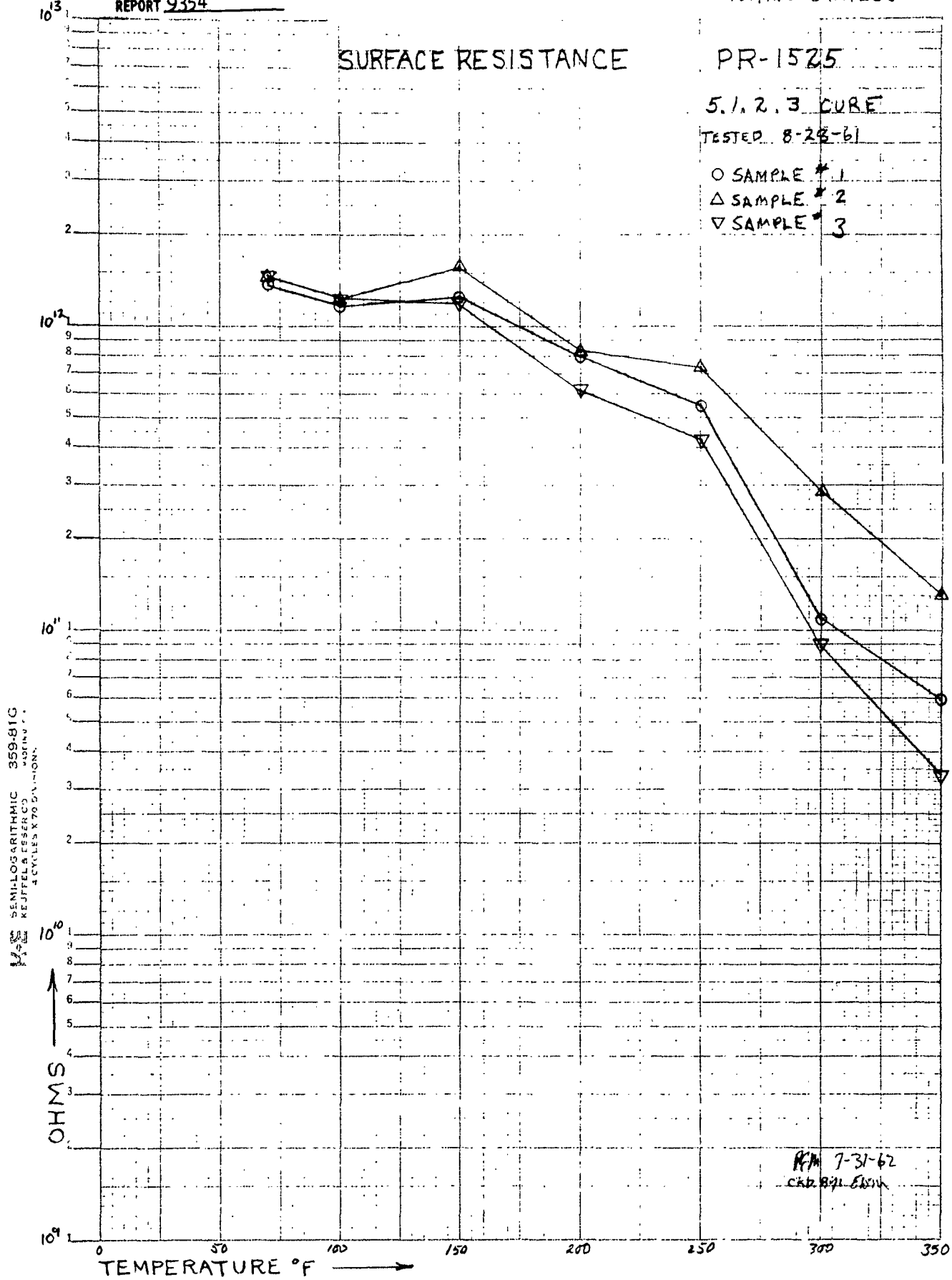
O SAMPLE #1
△ SAMPLE #2
▽ SAMPLE #3
OHMS
TEMPERATURE °F
0 50 100 150 200 250 300 350
10^{13} 10^{12} 10^{11} 10^{10} 10^{9}
SEMI-LOGARITHMIC 359-81G
K+E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PR-1525
5.1.2.3 CURE
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OHMS
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50
100
150
200
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350
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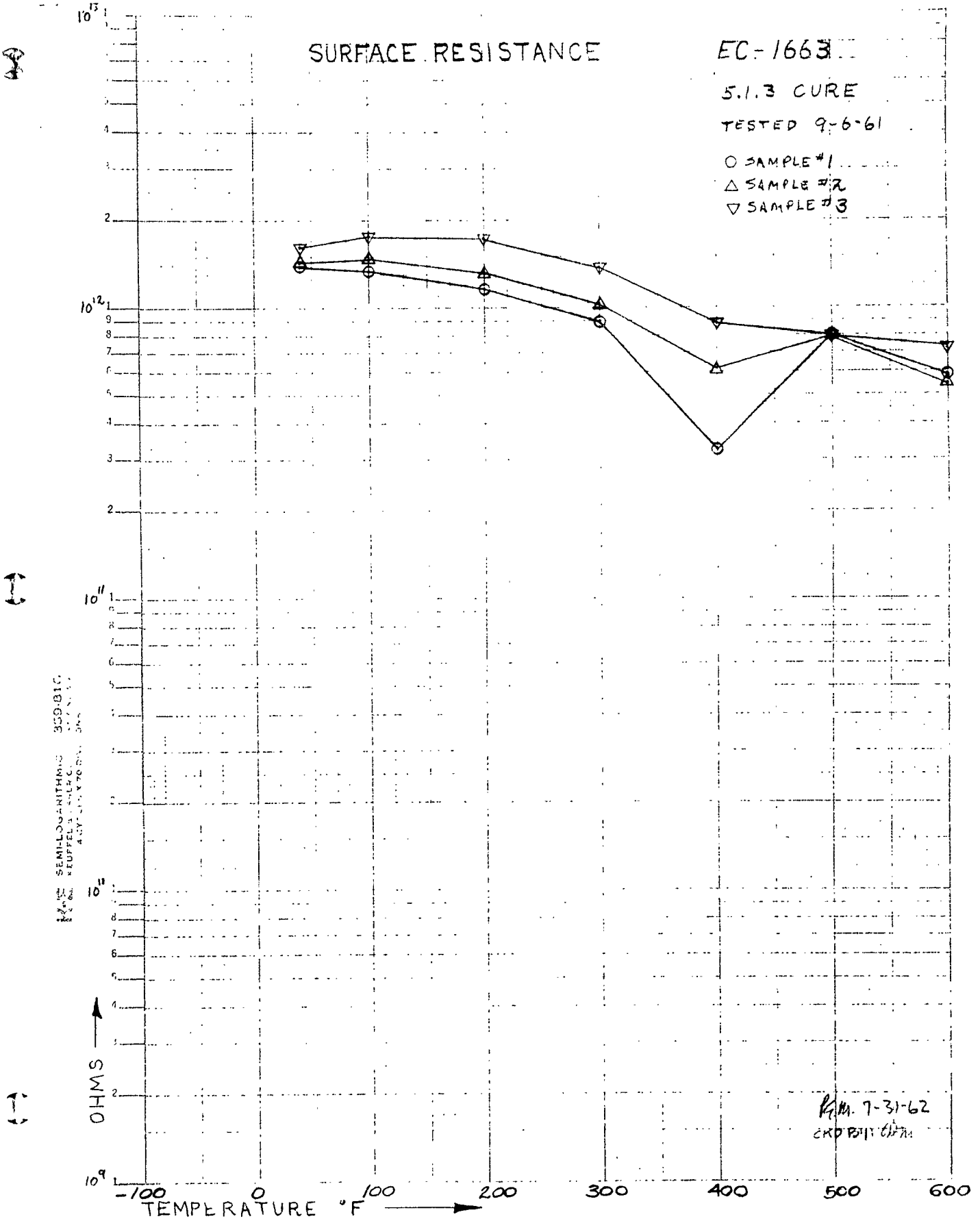
POTTING SAMPLES



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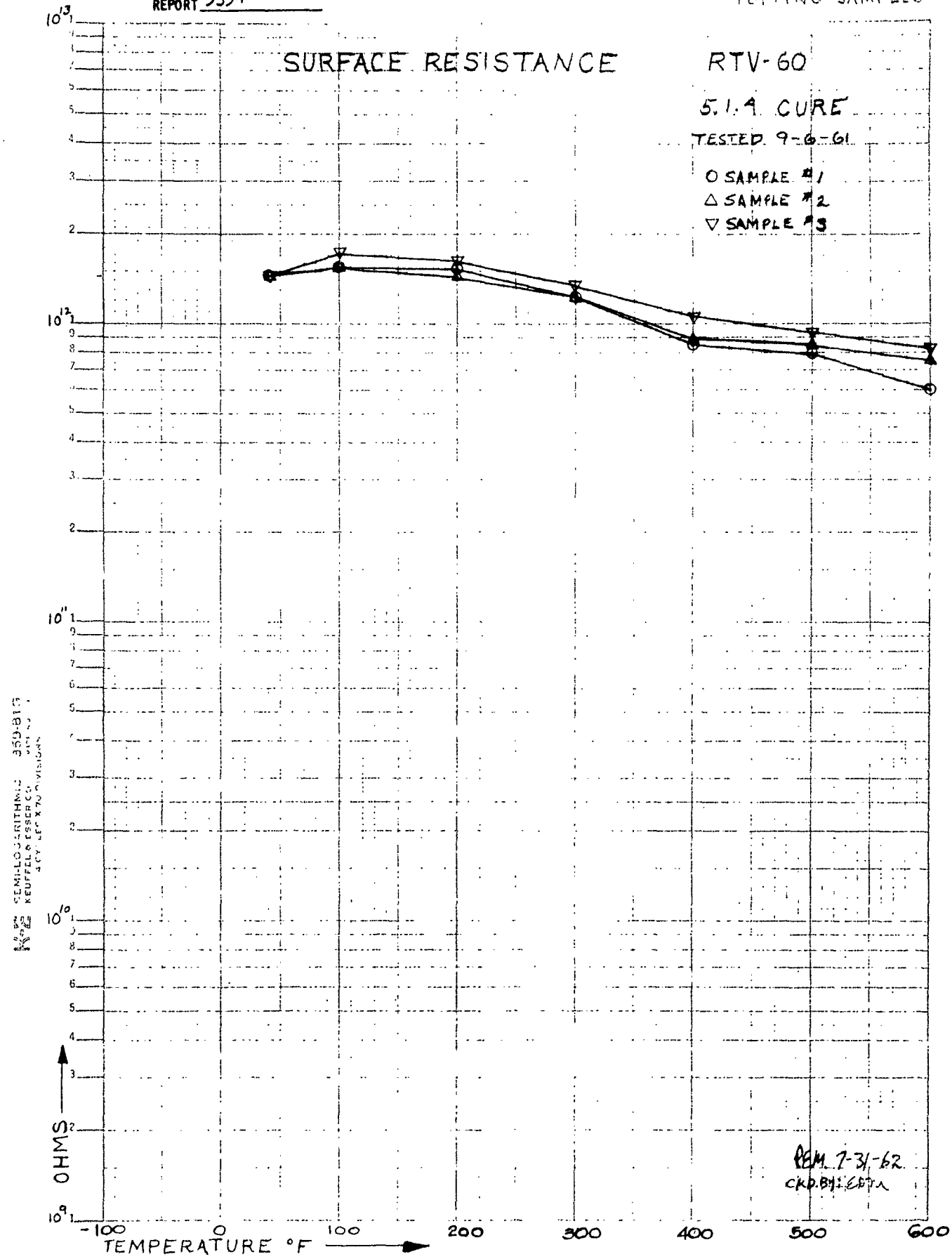
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RTV-60
5.1.9 CURE
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△ SAMPLE #2
▽ SAMPLE #3
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TEMPERATURE °F
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400
500
600
PGM 7-31-62
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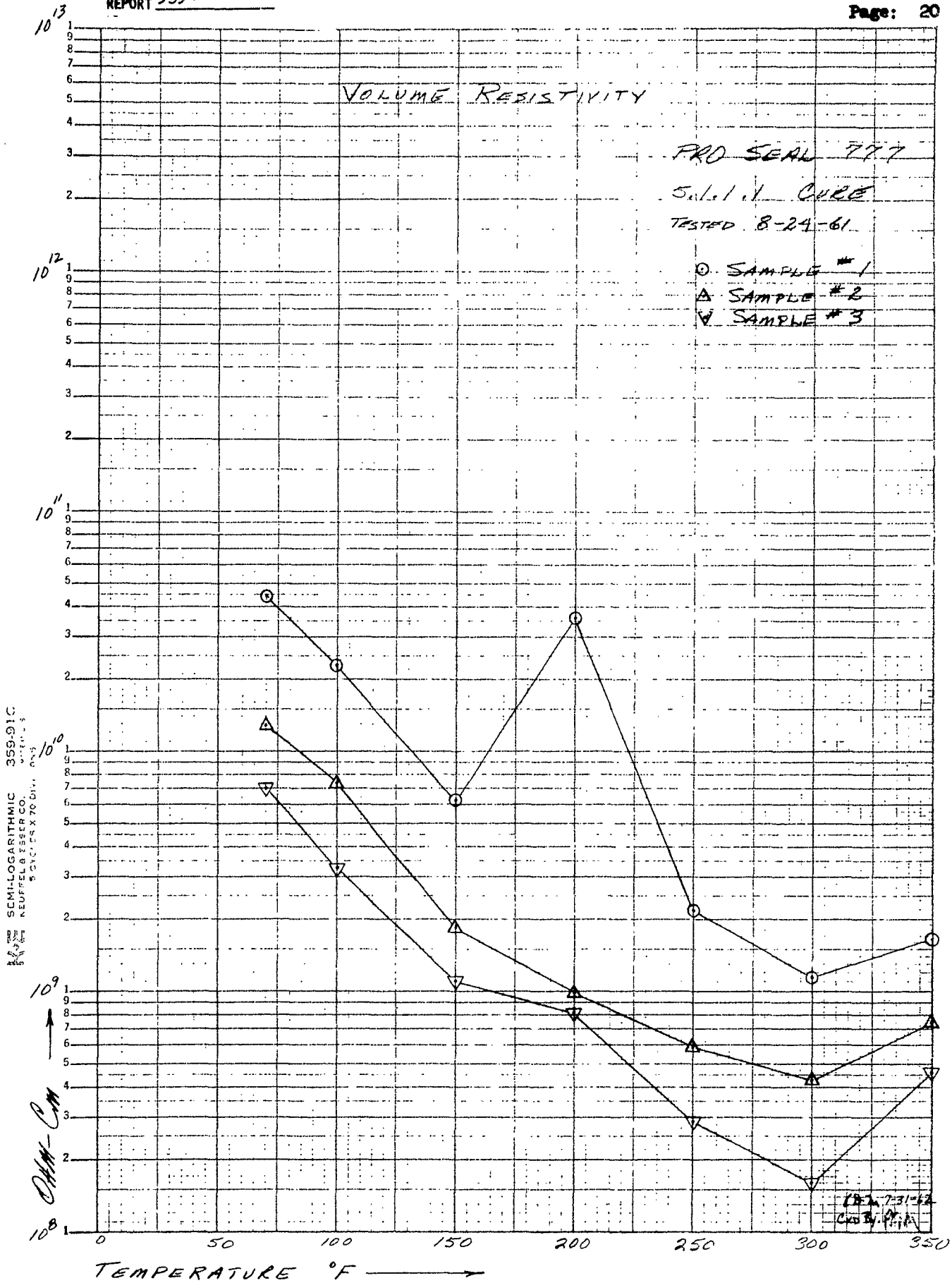
VOLUME RESISTIVITY
PRO SEAL 777
5.1.1.V. CURE
TESTED 8-24-61
SAMPLE #1
SAMPLE #2
SAMPLE #3
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359-91C
OHM-CM
TEMPERATURE °F
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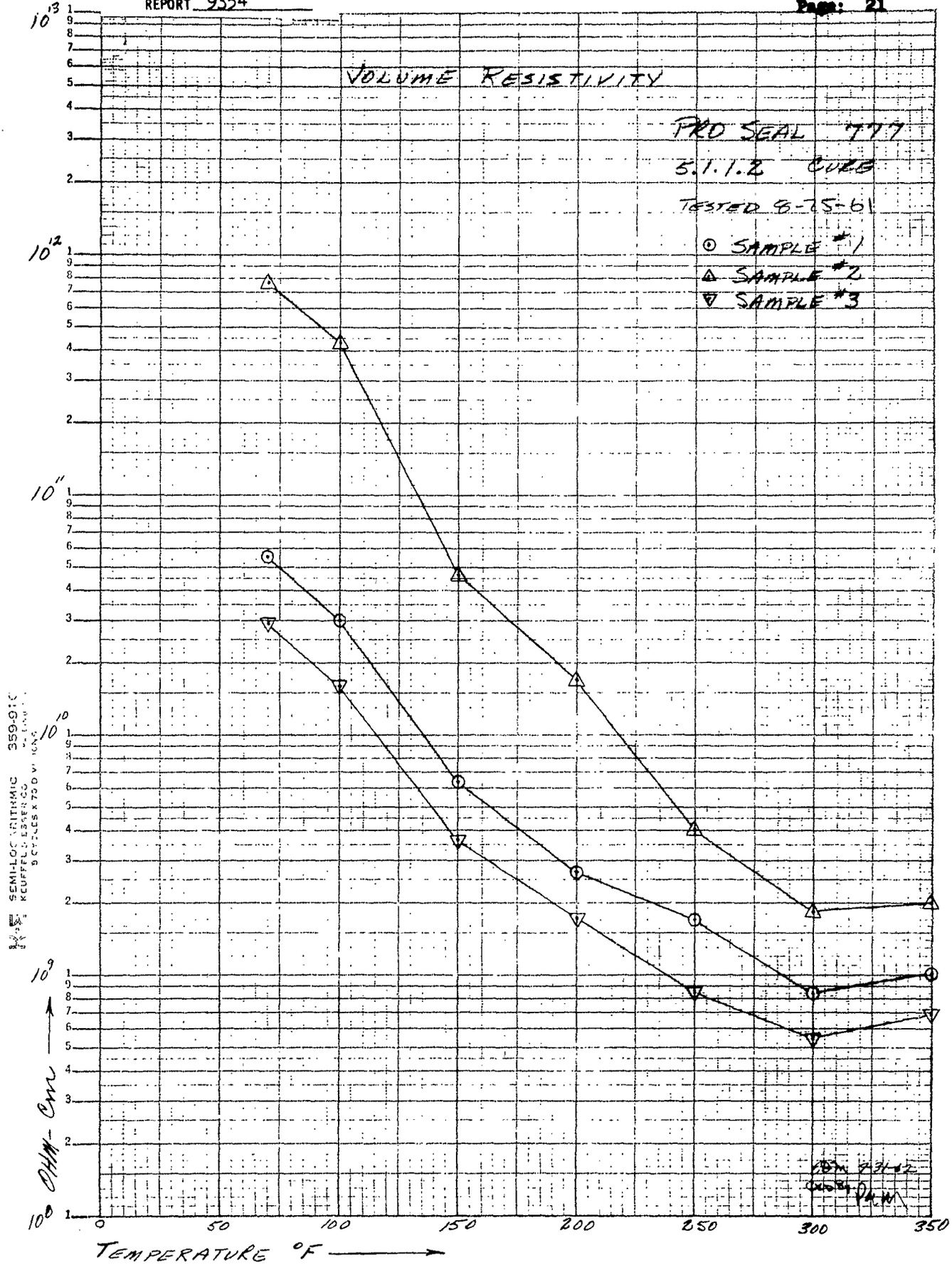
150
200
250
300
350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PRO SEAL 777
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SAMPLE #2
SAMPLE #3
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TEMPERATURE °F
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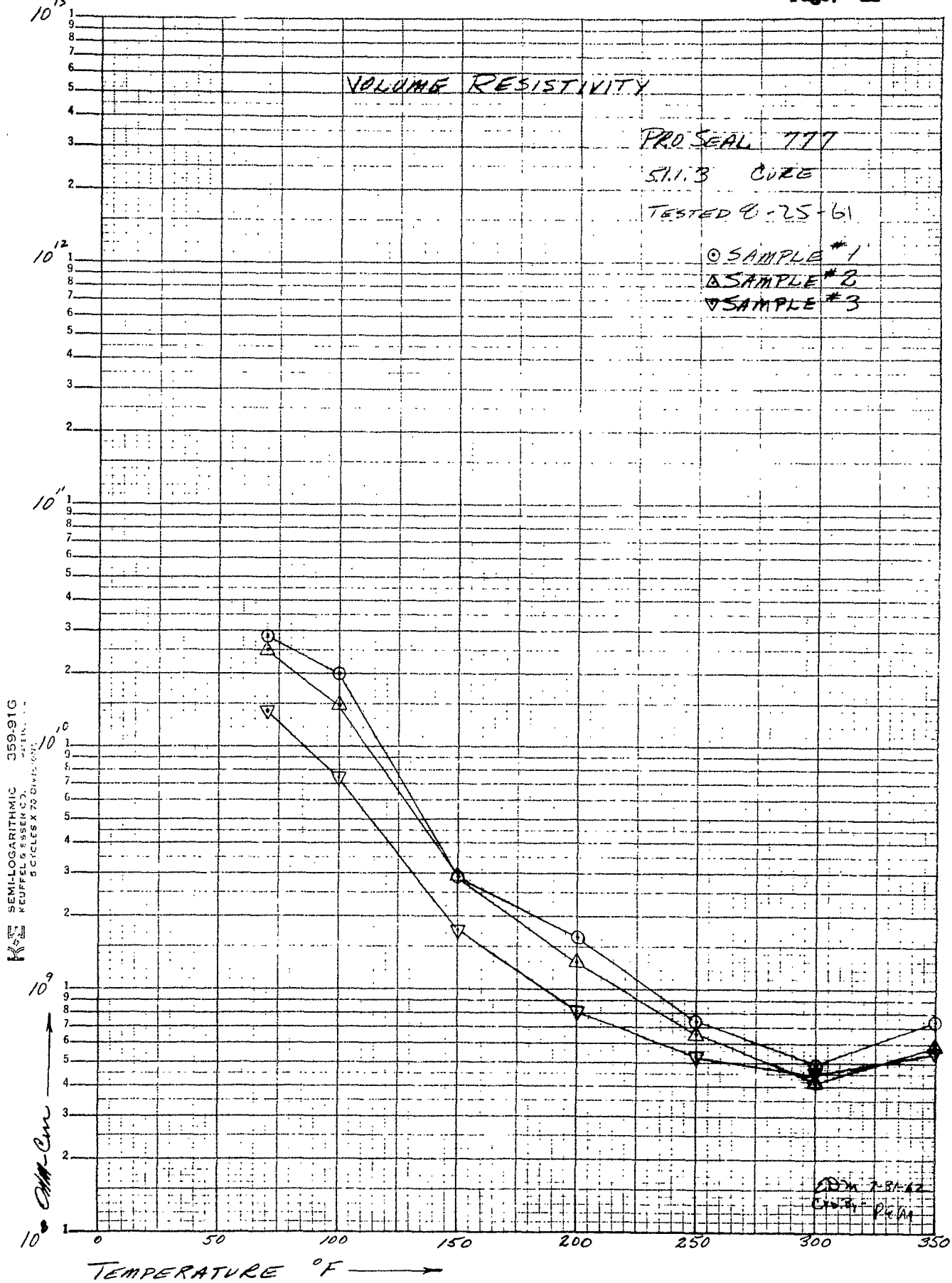
150
200
250
300
350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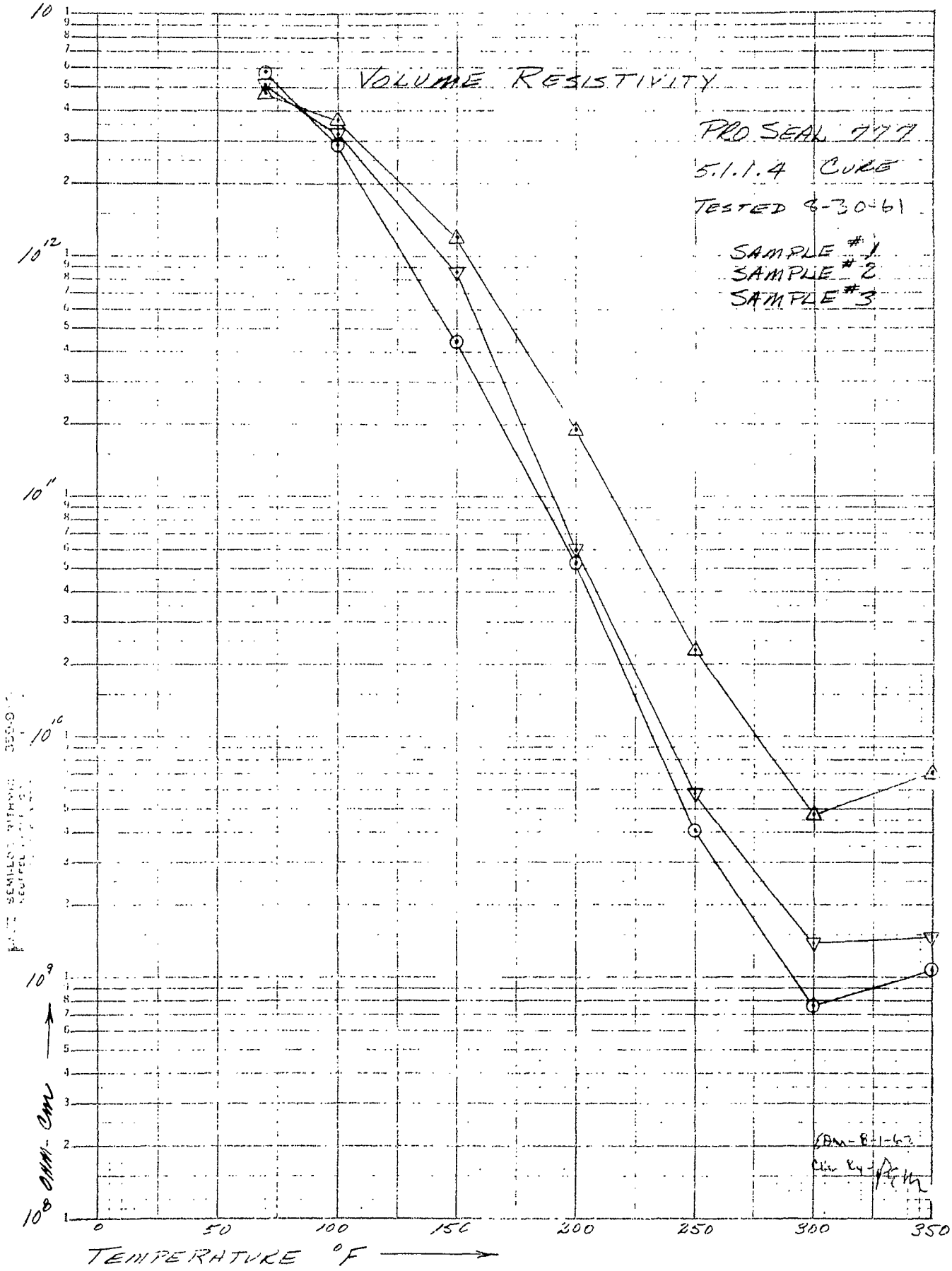
PRO SEAL 777
5.1.1.3 CURE
TESTED 8-25-61
⊙ SAMPLE #1
△ SAMPLE #2
▽ SAMPLE #3
SEMI-LOGARITHMIC 359-91G
KEUFFEL & ESSER CO.
5 CYCLES X 70 DIVISIONS
OHM-CM
TEMPERATURE °F
0
50
100
150
200
250
300
350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PRO SEAL 777
5.1.1.4 CURE
TESTED 6-30-61
SAMPLE #1
SAMPLE #2
SAMPLE #3
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10^12
10^11
10^10
10^9
10^8
OHM-CM
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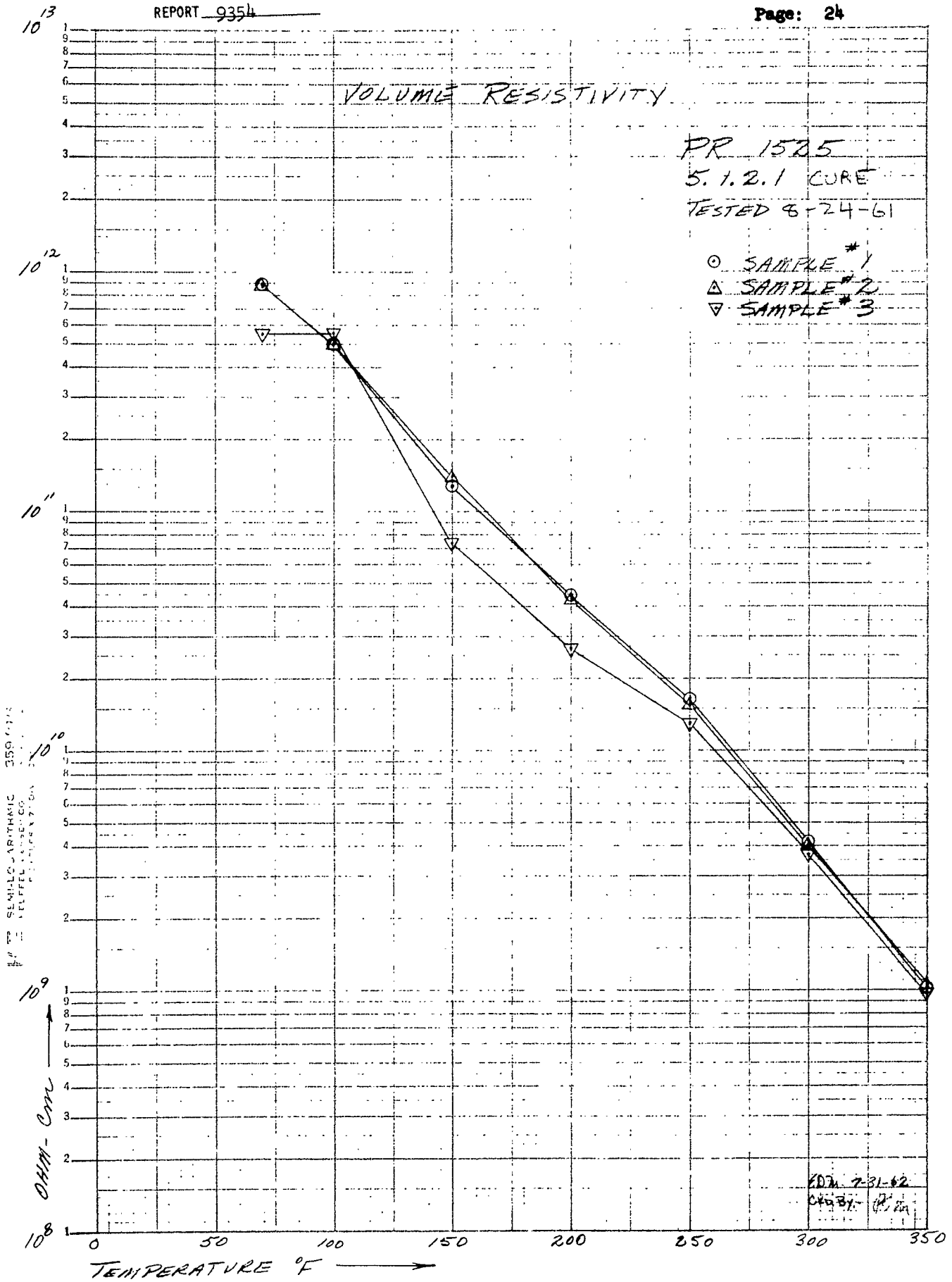
100
150
200
250
300
350
TEMPERATURE °F

POTTING SAMPLES



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Potting Sample #2
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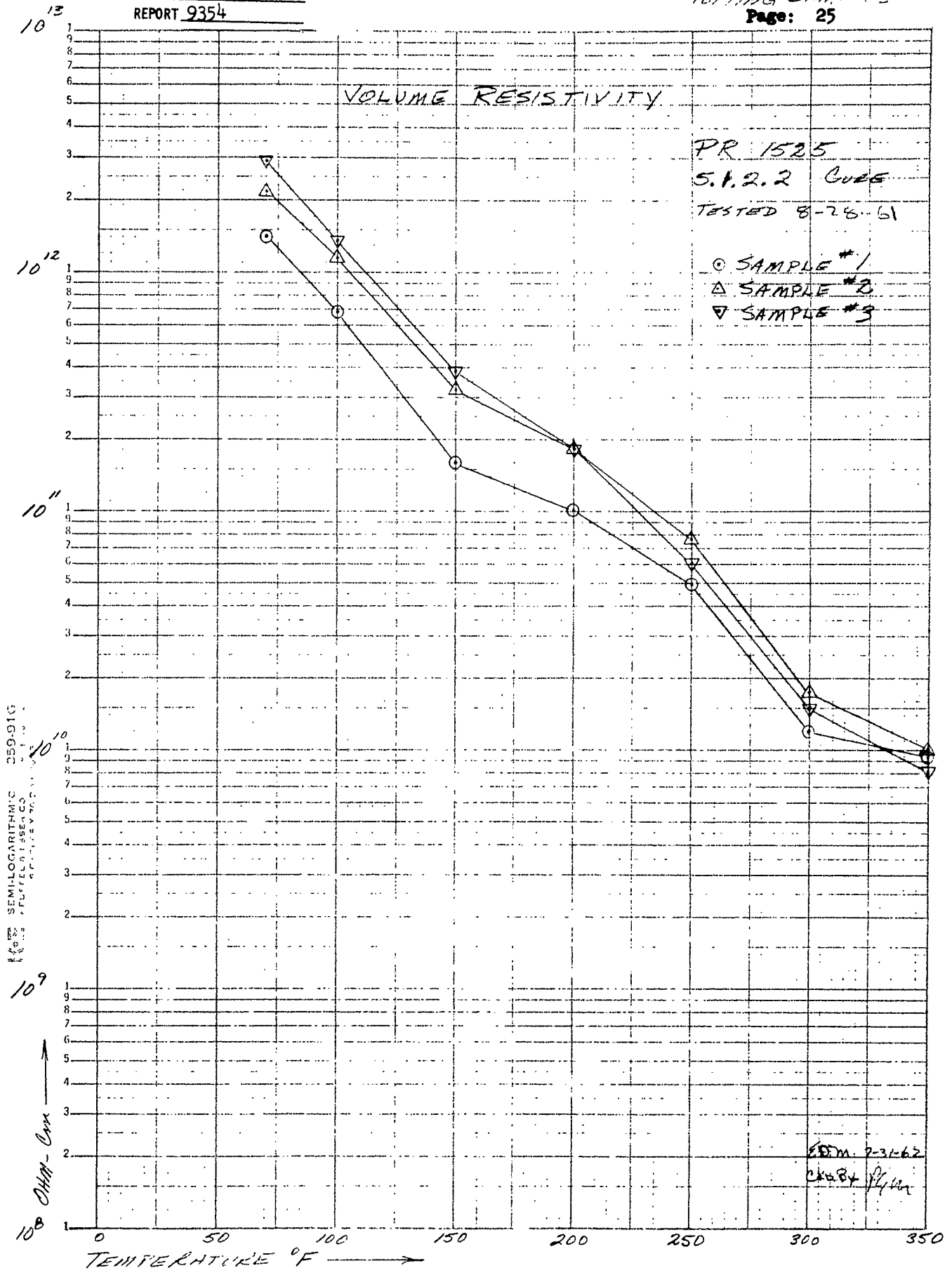

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FITTING SAMPLES
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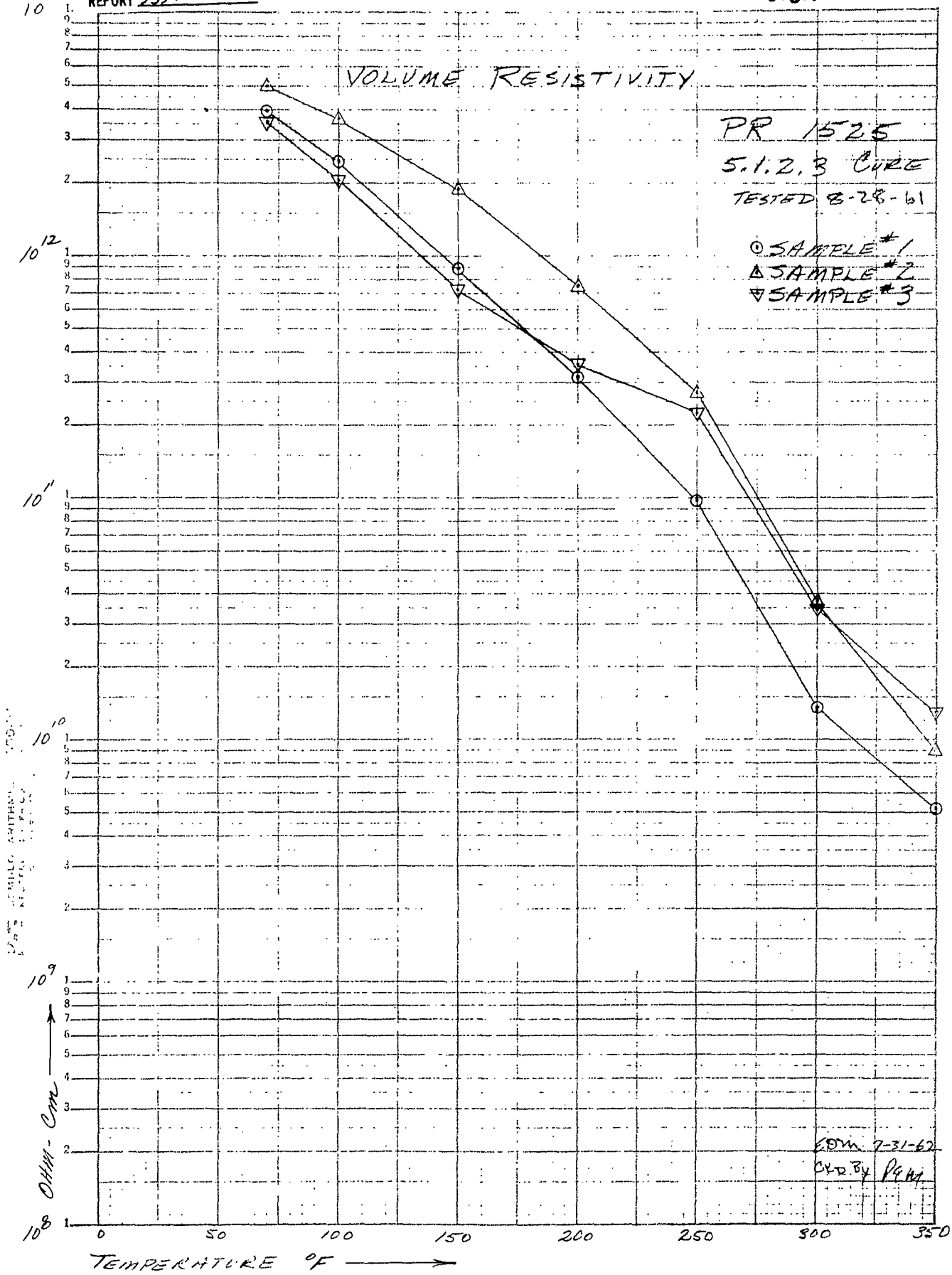

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Potting Samples

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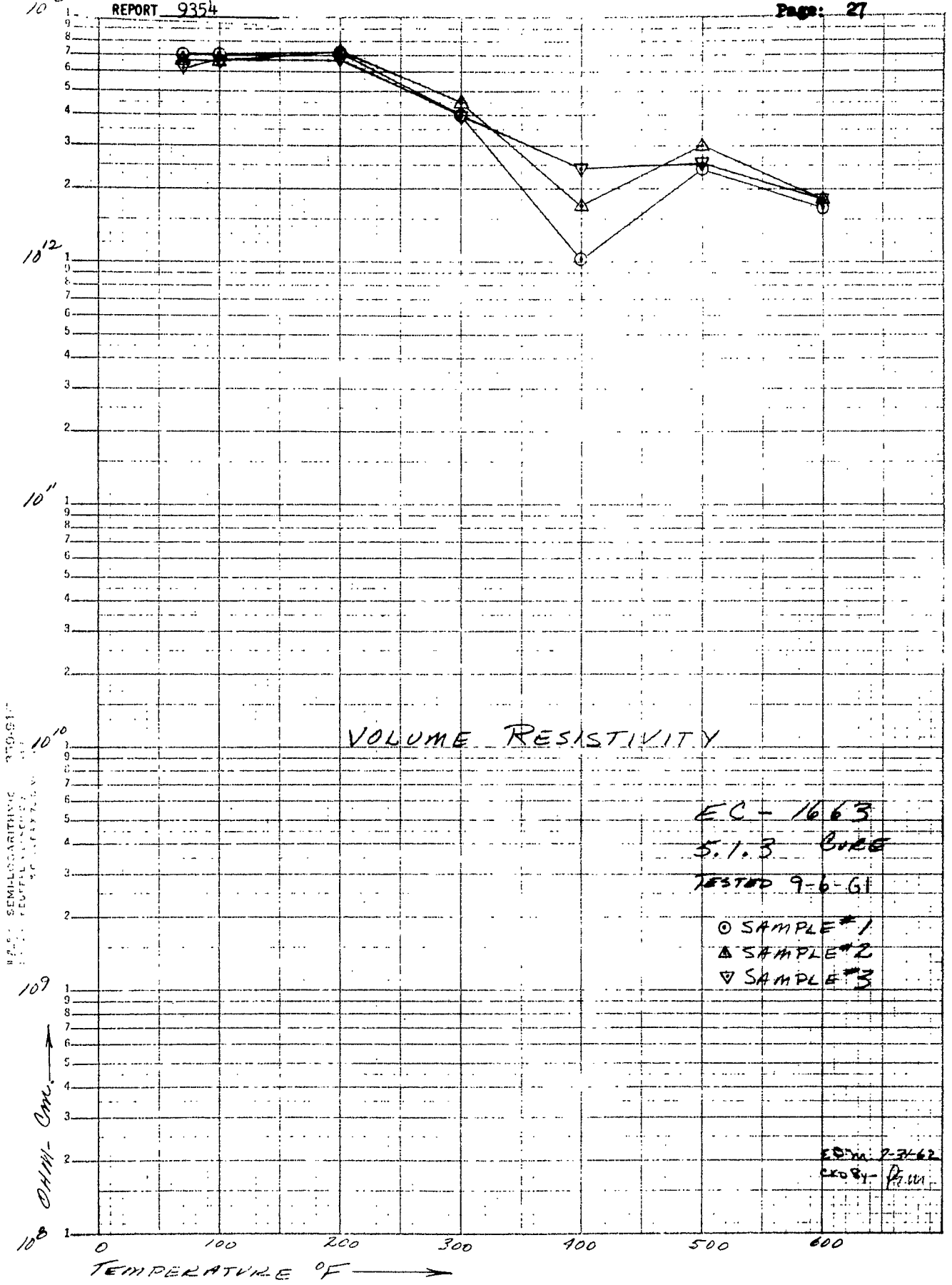

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POTTING COMPOUNDS

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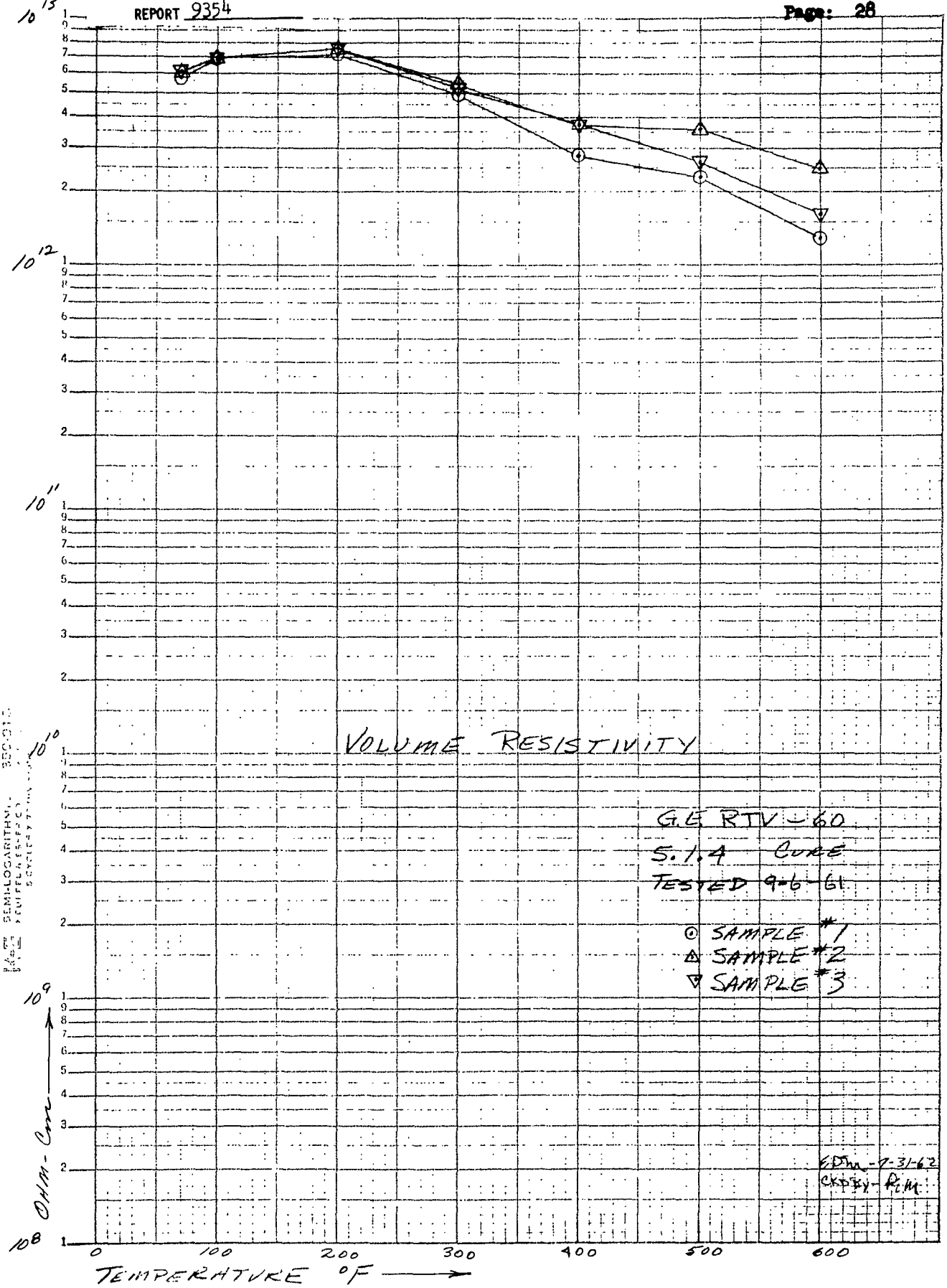

POTTING SAMPLES

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MODEL

DATE

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MODEL DATE

POTTING SAMPLES

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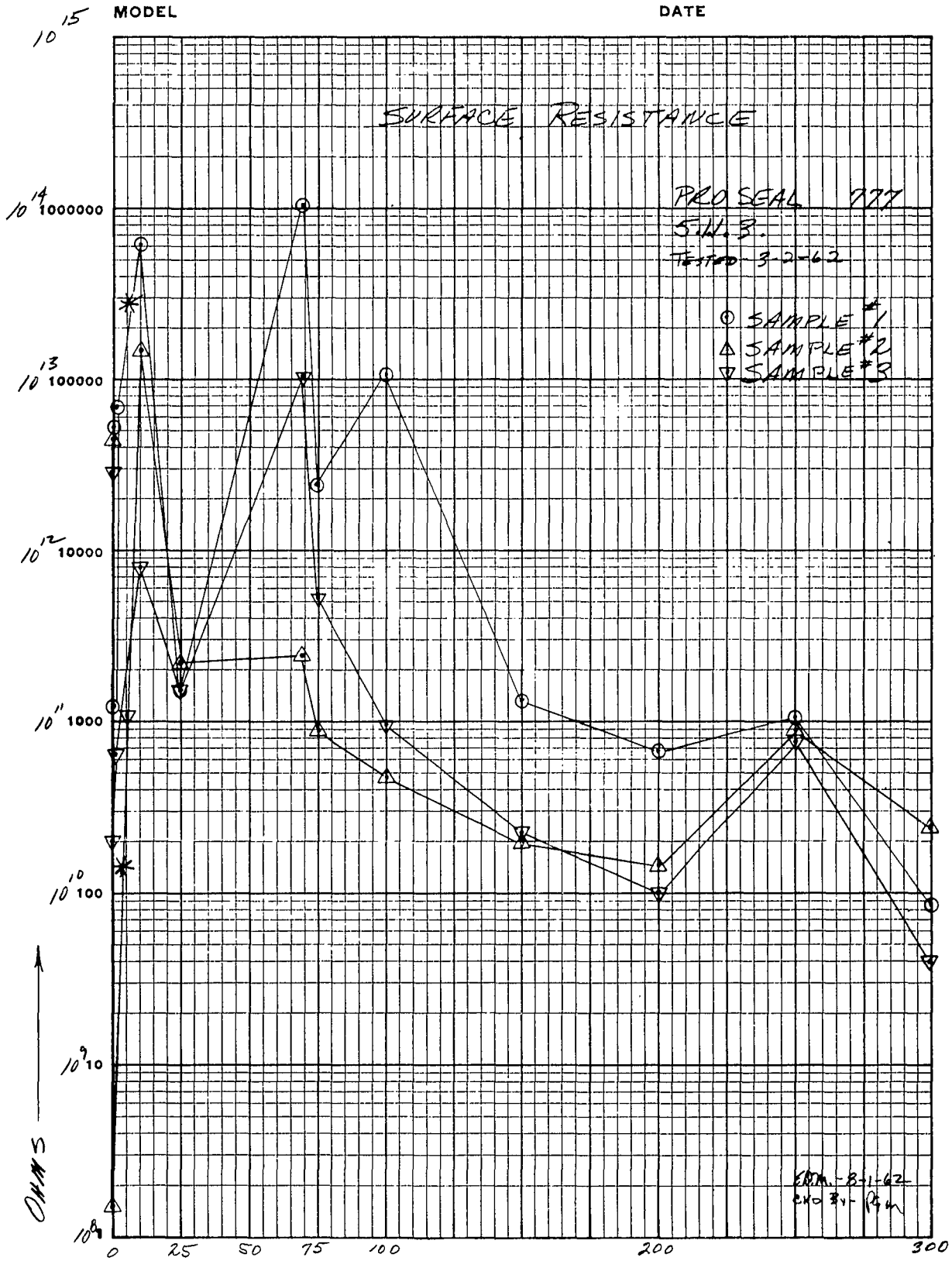
Page: 31

MODEL

DATE



* READINGS NOT TAKEN BETWEEN THESE POINTS.

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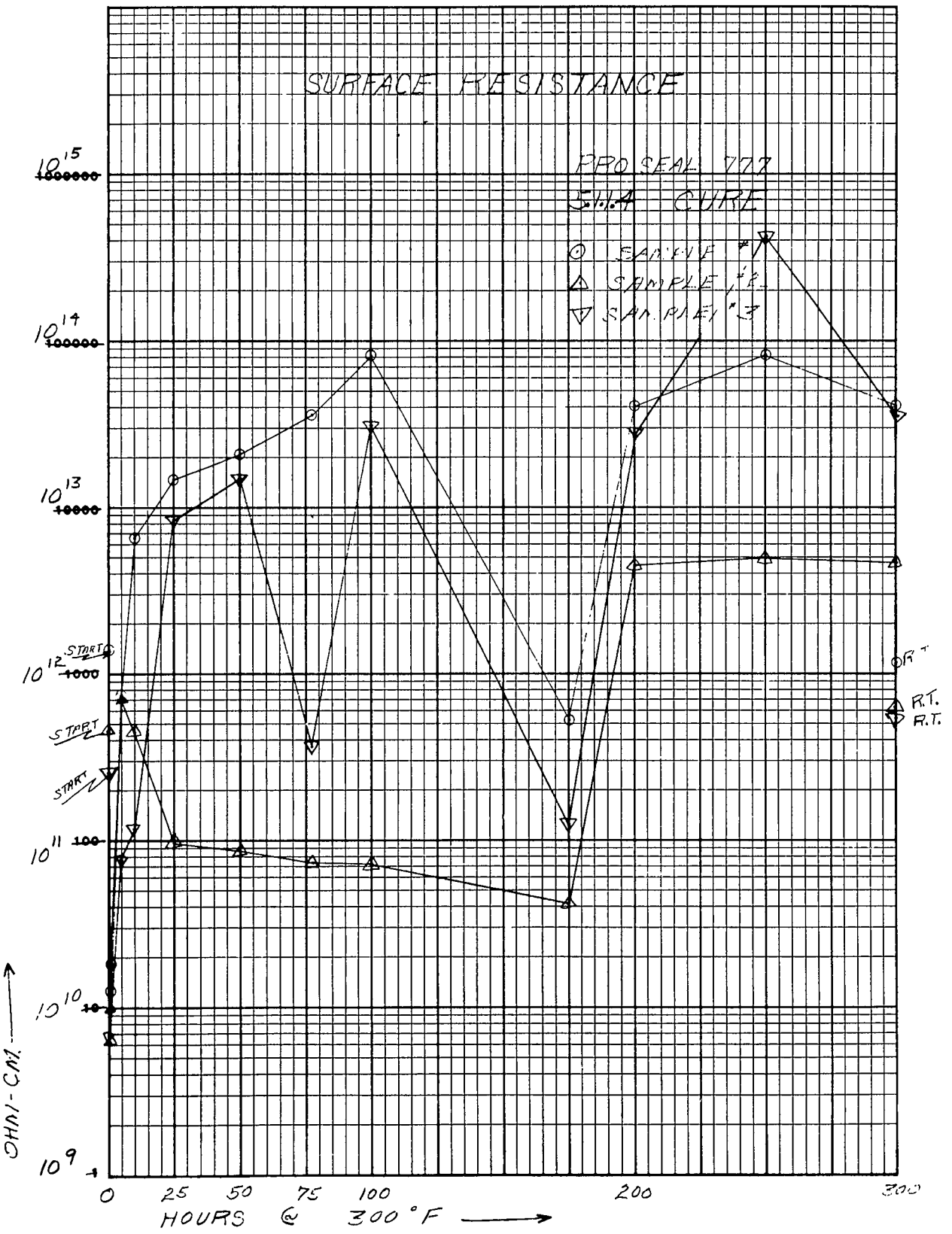
SURFACE RESISTANCE
PPO SEAL 777
5.1.A CURE
SAMPLE #1
SAMPLE #2
SAMPLE #3
10^{15} 1000000
10^{14} 100000
10^{13} 10000
10^{12} 1000
10^{11} 100
10^{10} 10
10^9
START
START
START
R.T.
R.T.
R.T.
OHM-CM.
0 25 50 75 100 200 300
HOURS @ 300°F

POTTING SAMPLES

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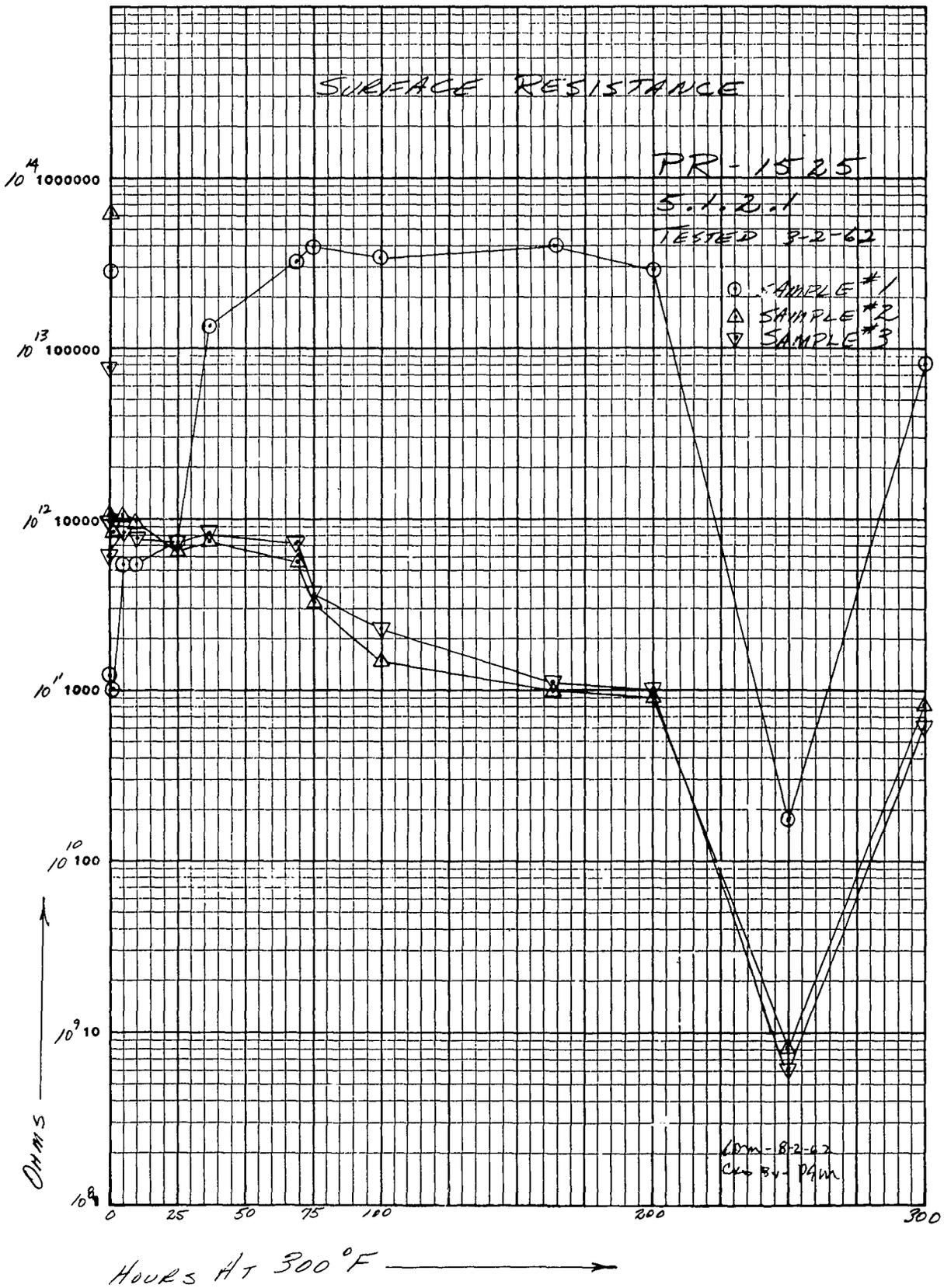
MODEL

DATE



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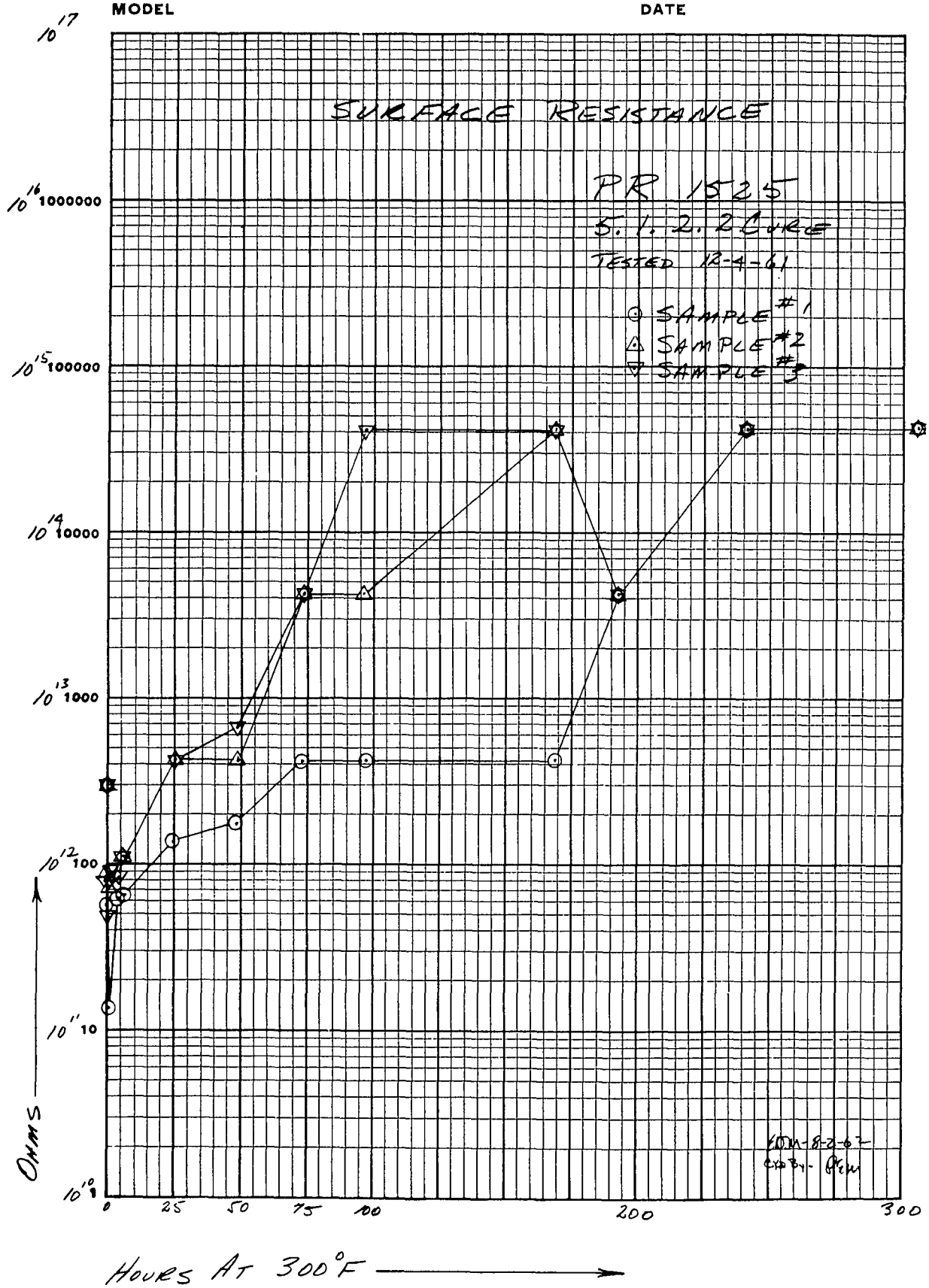
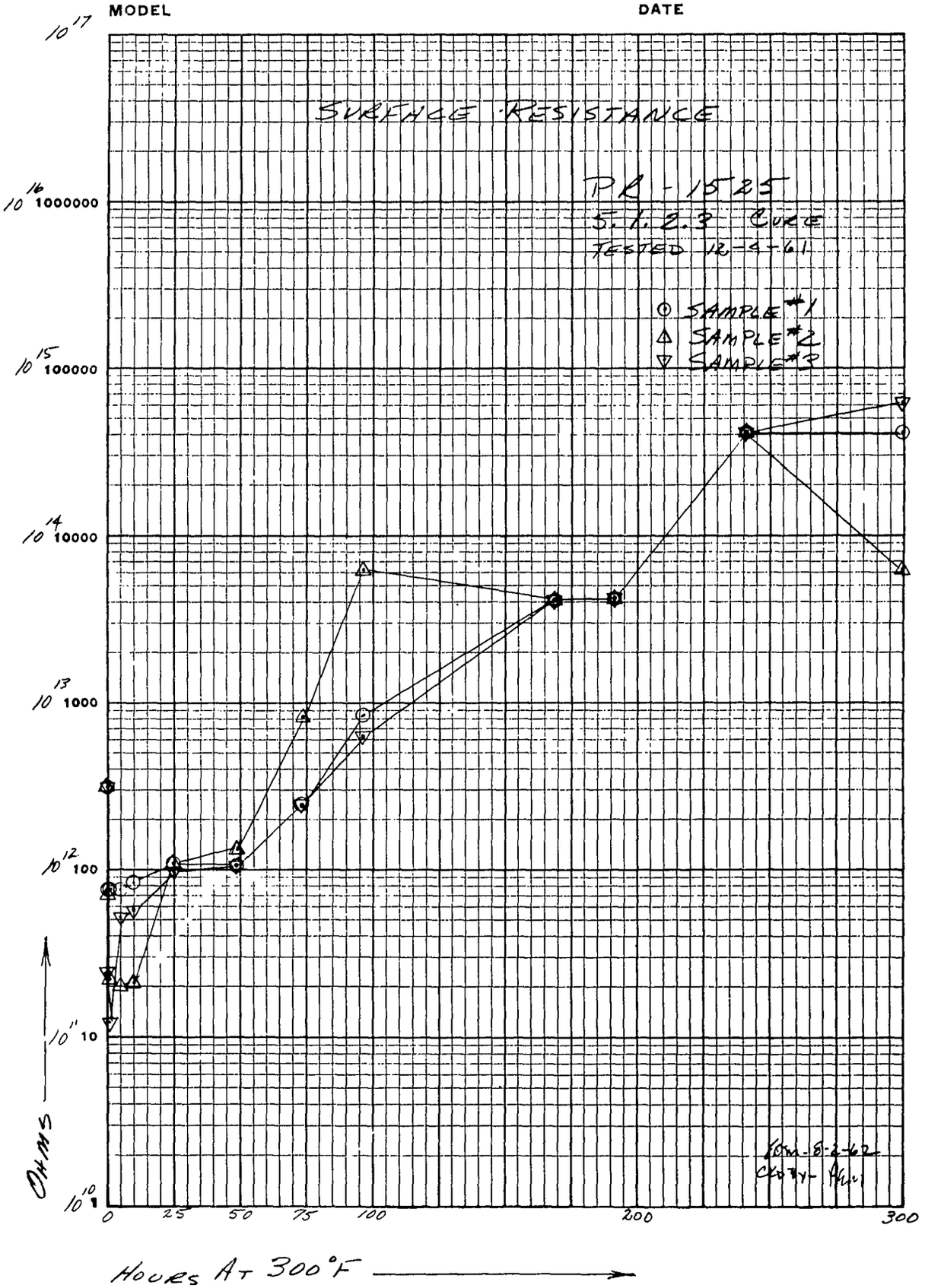

SURFACE RESISTANCE
PR 1525
5.1.2.2 CURE
TESTED 12-4-61
SAMPLE #1
SAMPLE #2
SAMPLE #3
10^{17}
10^{16} 1000000
10^{15} 100000
10^{14} 10000
10^{13} 1000
10^{12} 100
10^{11} 10
10^{10} 1
OHMS
0
25
50
75
100
200
300
HOURS AT 300°F

POTTING SAMPLES

MODEL

DATE



POTTING SAMPLES

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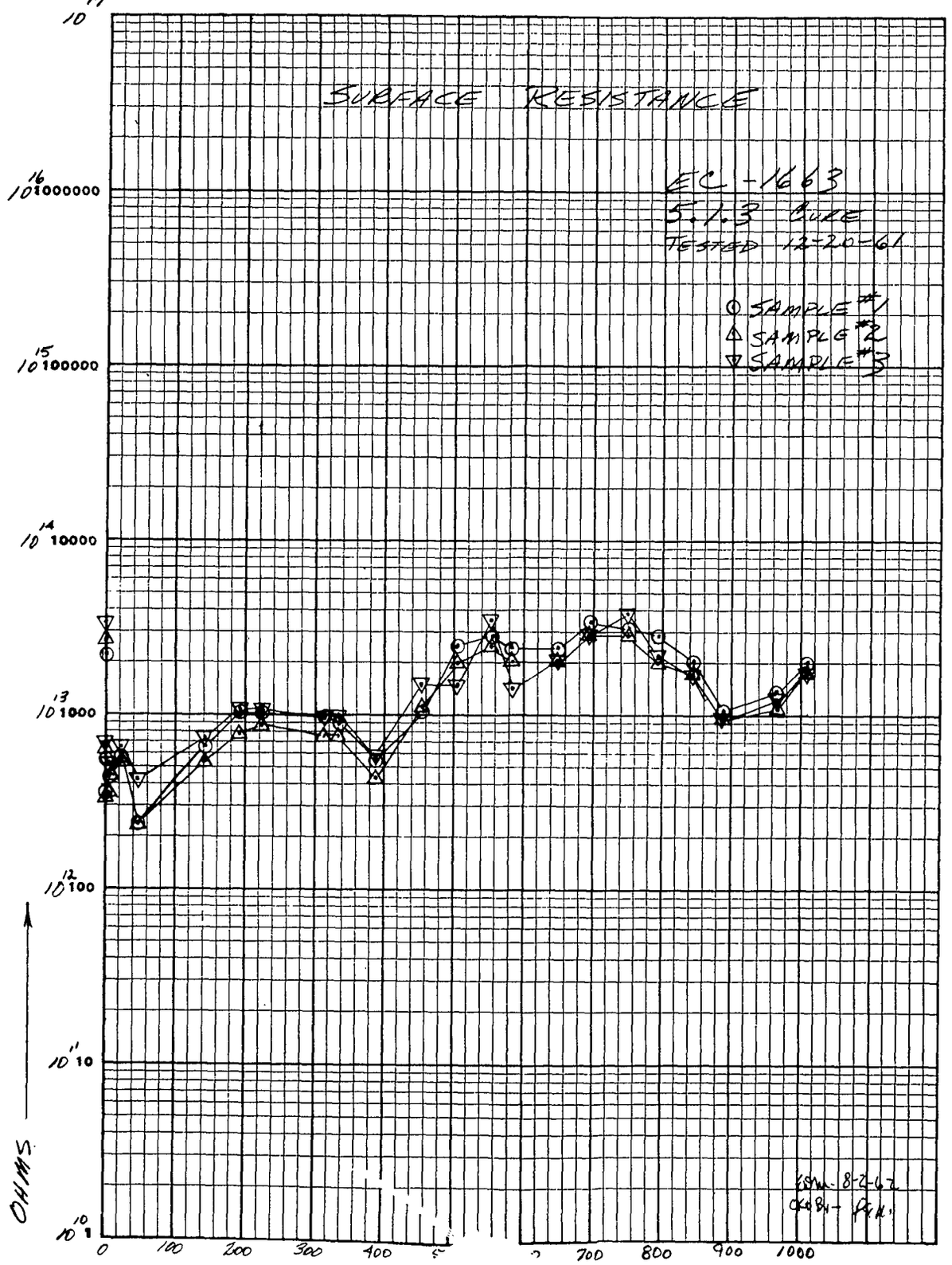
MODEL

DATE



HOURS AT 500 °F

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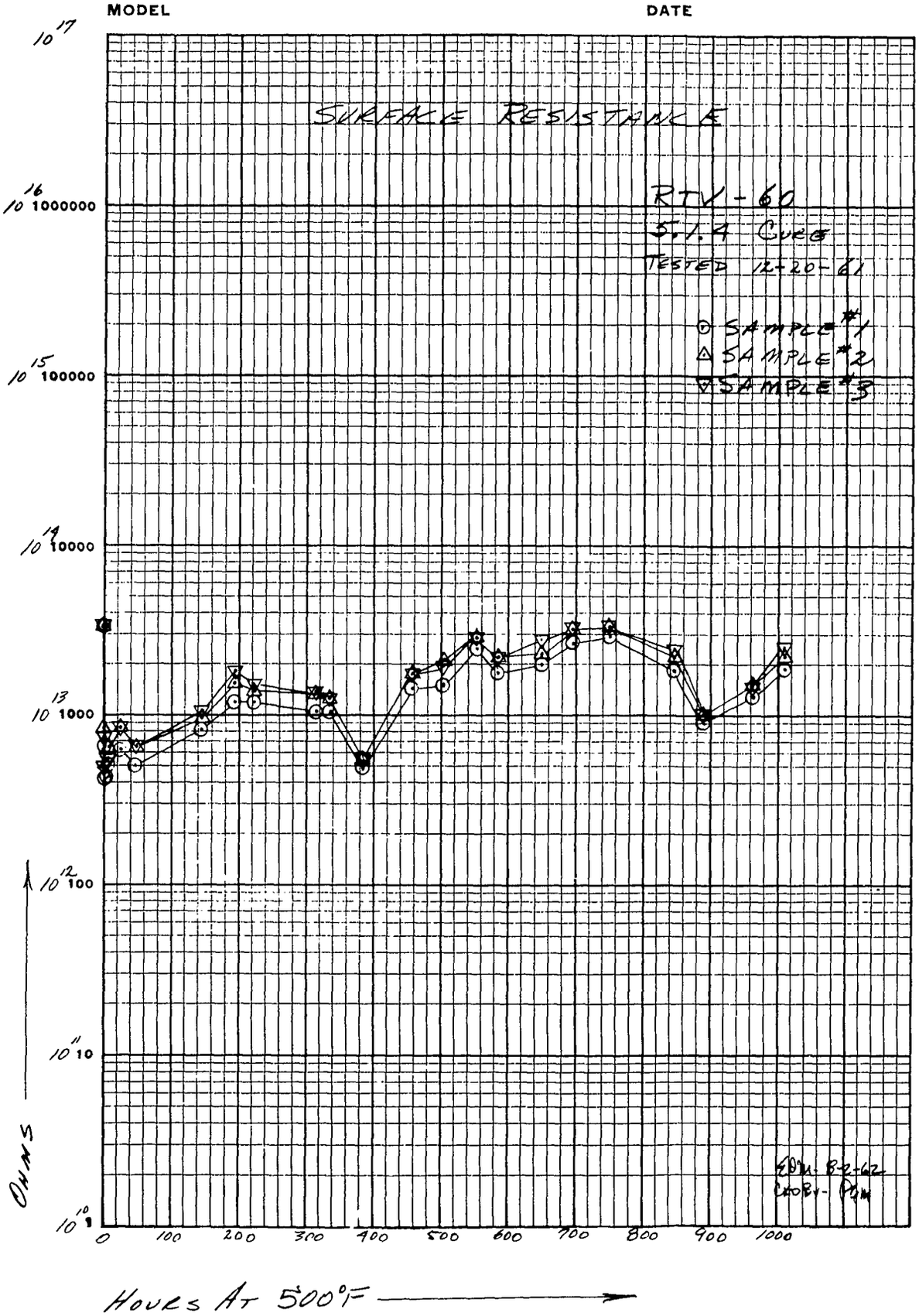
MODEL DATE



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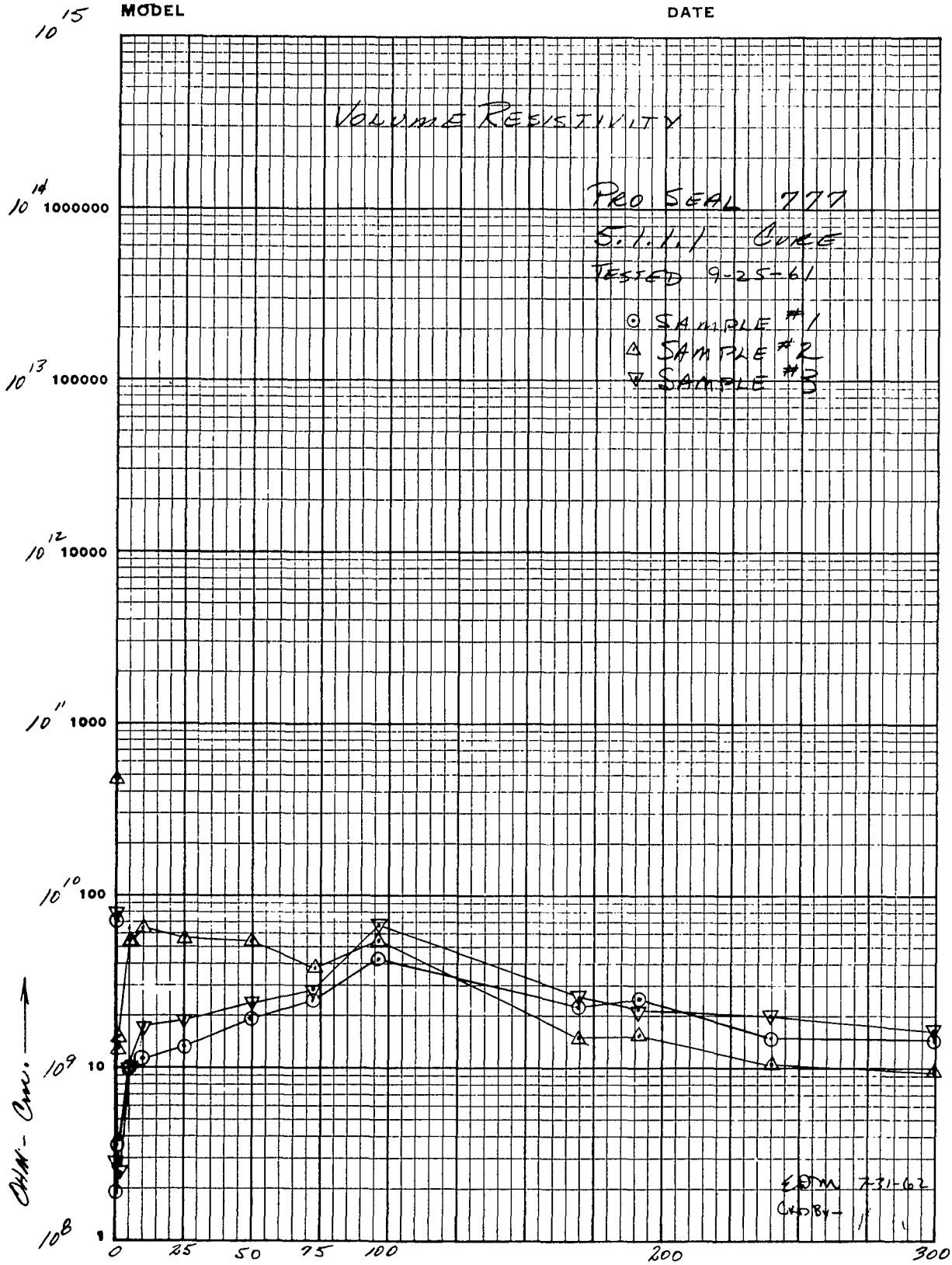
VOLUME RESISTIVITY
PRO SEAL 777
5.1.1.1 CURE
TESTED 9-25-61
⊙ SAMPLE #1
△ SAMPLE #2
▽ SAMPLE #3
10^{15}
10^{14} 1000000
10^{13} 100000
10^{12} 10000
10^{11} 1000
10^{10} 100
10^{9} 10
10^{8} 1
OHM-CM. ⟶
0 25 50 75 100 200 300
HOURS AT 300°F ⟶
EDM 7-31-62
CHKD BY

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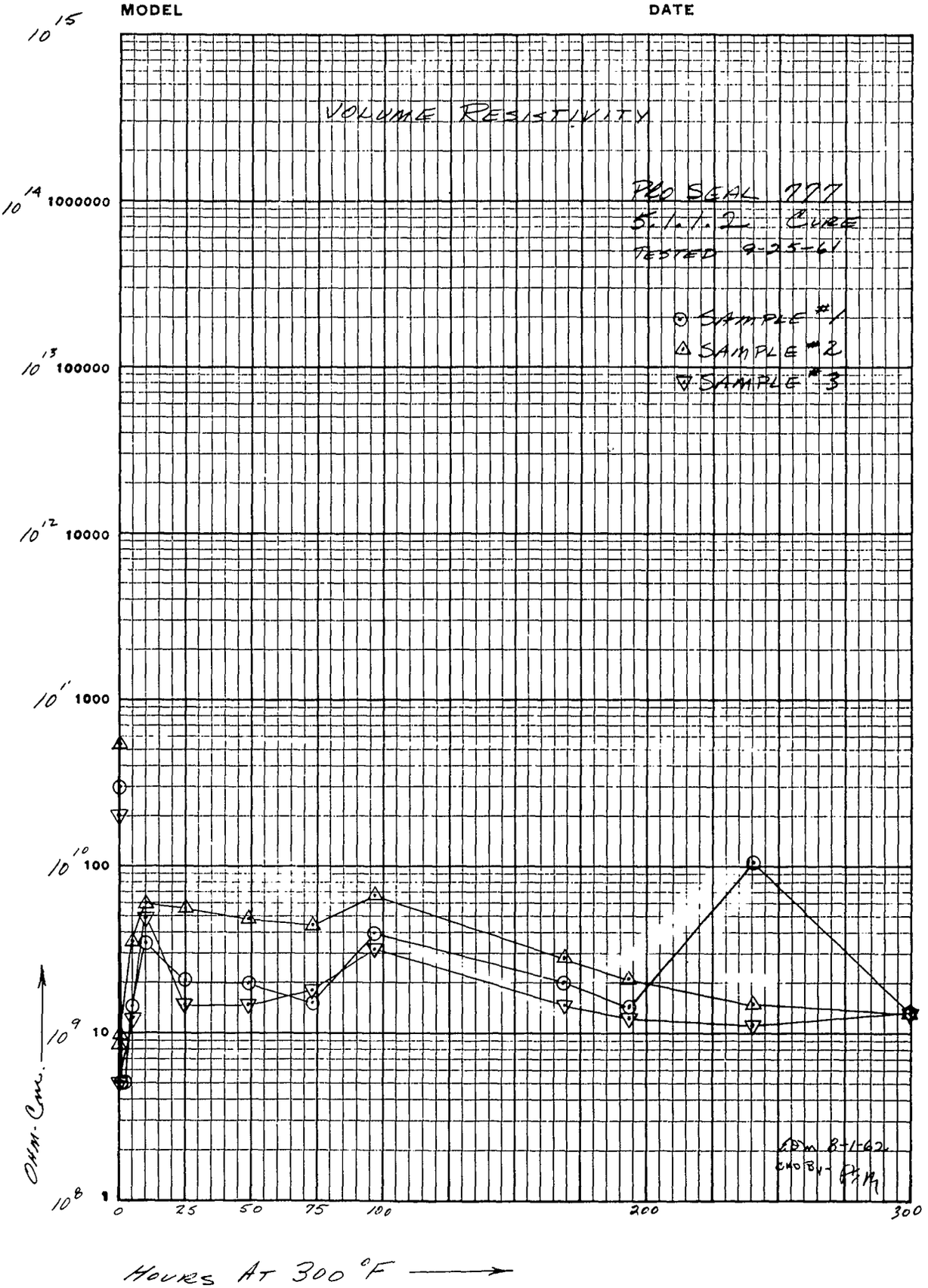
MODEL DATE



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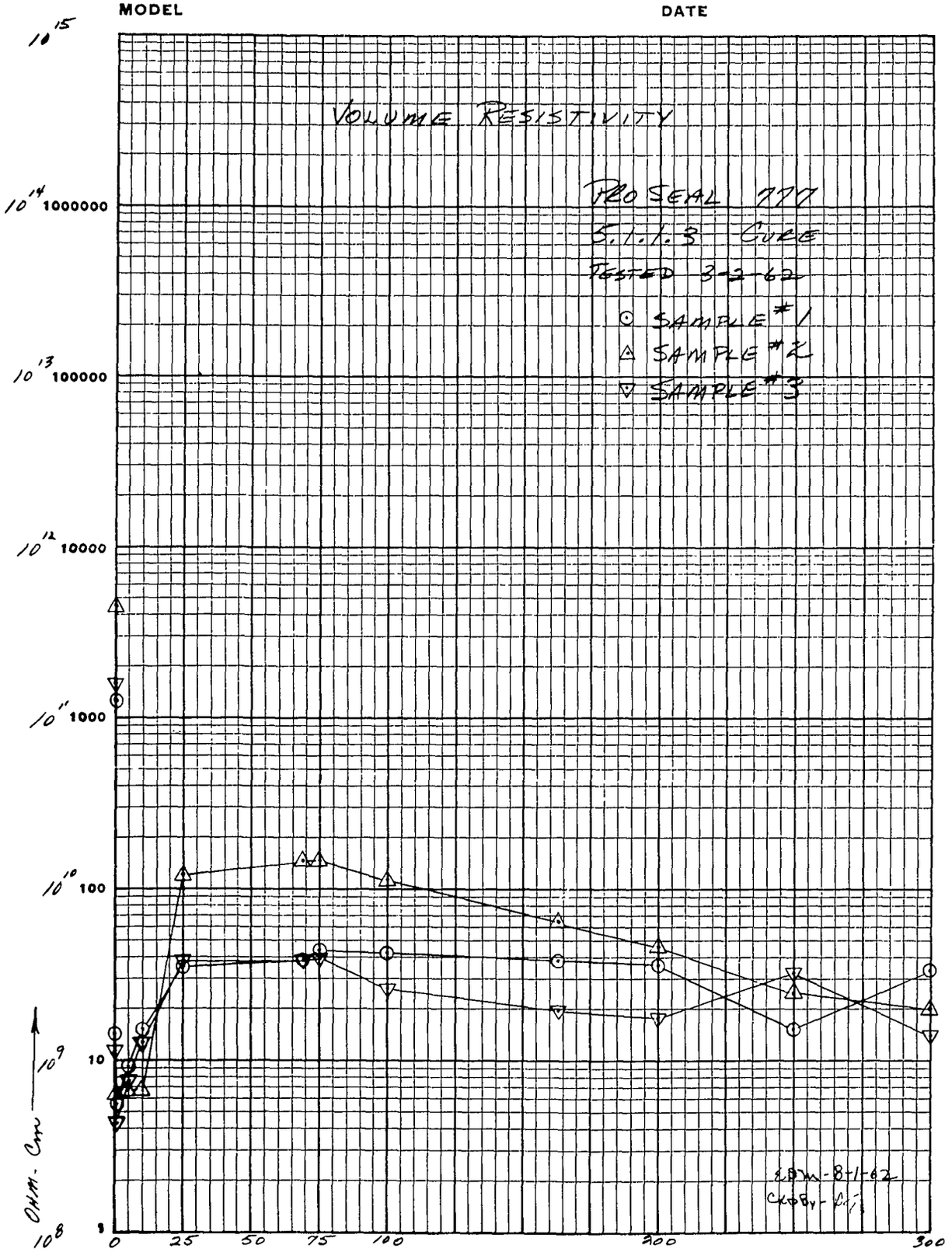
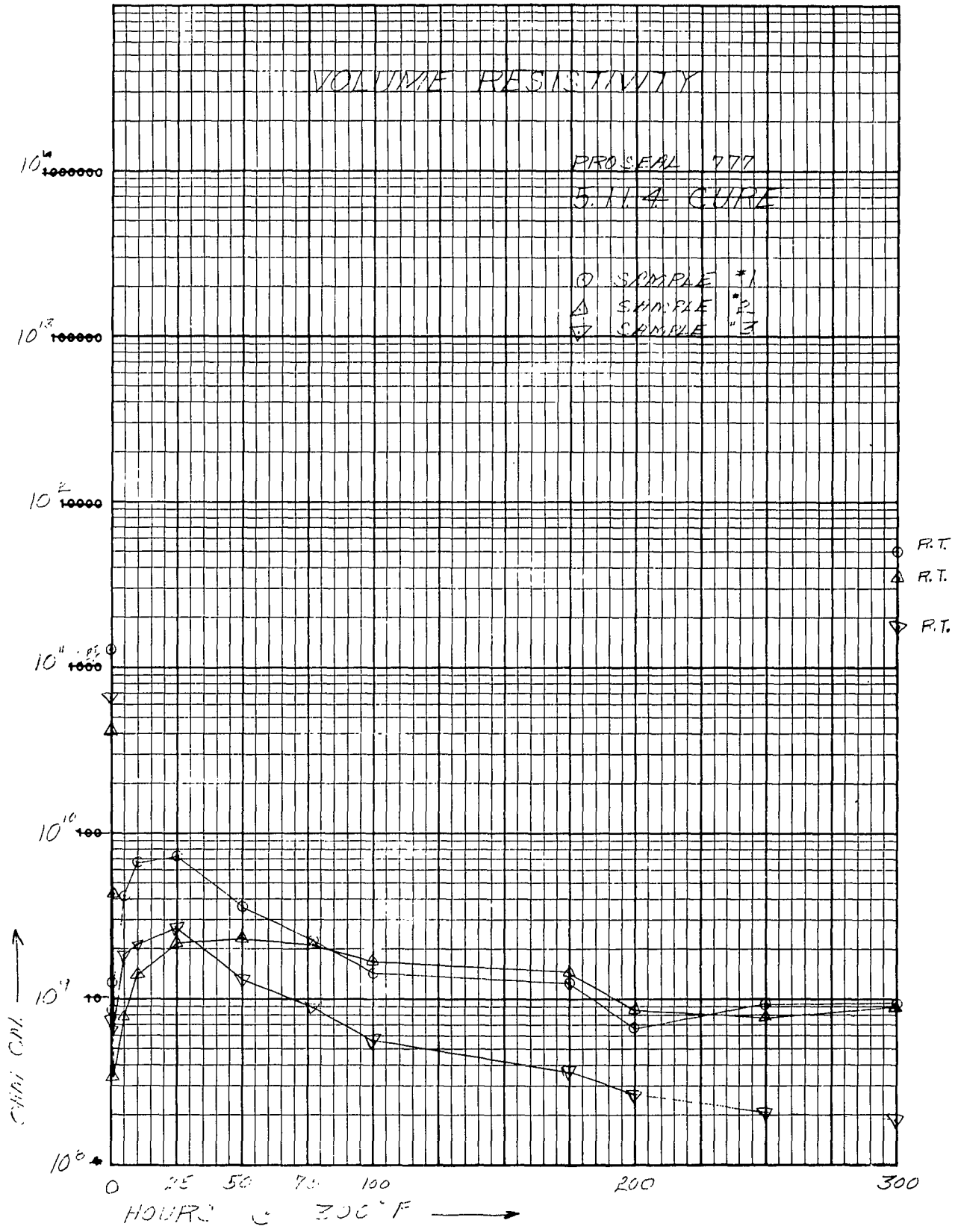

VOLUME RESISTIVITY
PROSEAL 777
5.1.1.3 CURE
TESTED 3-2-62
SAMPLE #1
SAMPLE #2
SAMPLE #3
10^{15}
10^{14} 1000000
10^{13} 100000
10^{12} 10000
10^{11} 1000
10^{10} 100
10^{9} 10
10^{8} 1
OHM-CM
0 25 50 75 100 200 300
HOURS AT 300° F

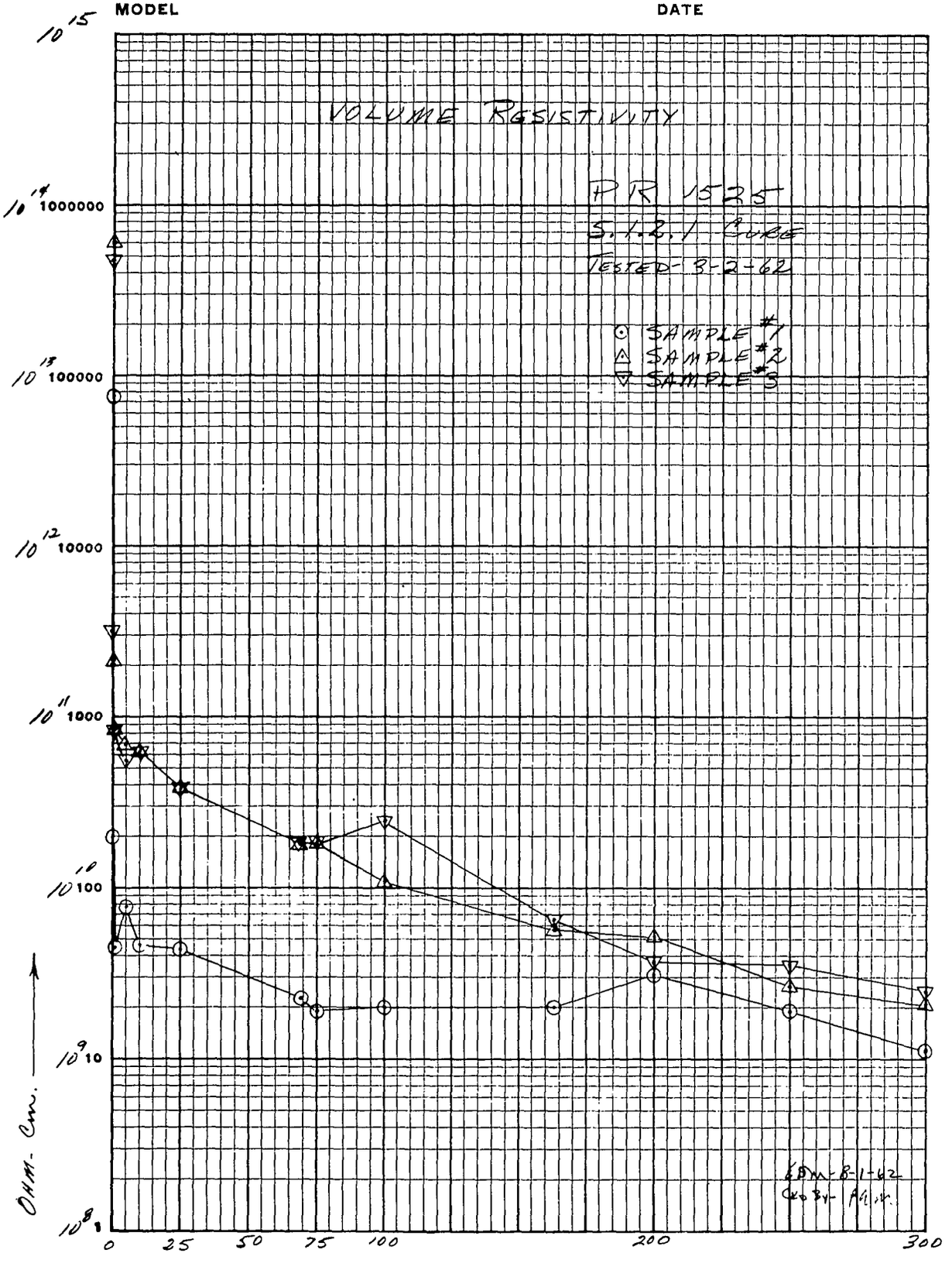
MODEL

DATE


VOLUME RESISTIVITY
PRO-SEAL 777
5.11.4 CURE
SAMPLE #1
SAMPLE #2
SAMPLE #3
R.T.
R.T.
R.T.
10^{14} 1000000
10^{13} 100000
10^{12} 10000
10^{11} 1000
10^{10} 100
10^{9} 10
10^{8}
OHM CM
0
25
50
75
100
200
300
HOURS @ 300°F

MODEL

DATE


VOLUME RESISTIVITY
PR 1525
5.1.2.1 CURE
TESTED- 3-2-62
SAMPLE #1
SAMPLE #2
SAMPLE #3
10^{15}
10^{14} 1000000
10^{13} 100000
10^{12} 10000
10^{11} 1000
10^{10} 100
10^{9} 10
10^{8} 1
OHM-CM.
0
25
50
75
100
200
300
HOURS AT 300°F
EBM-8-1-62
Cho By- AM.W.

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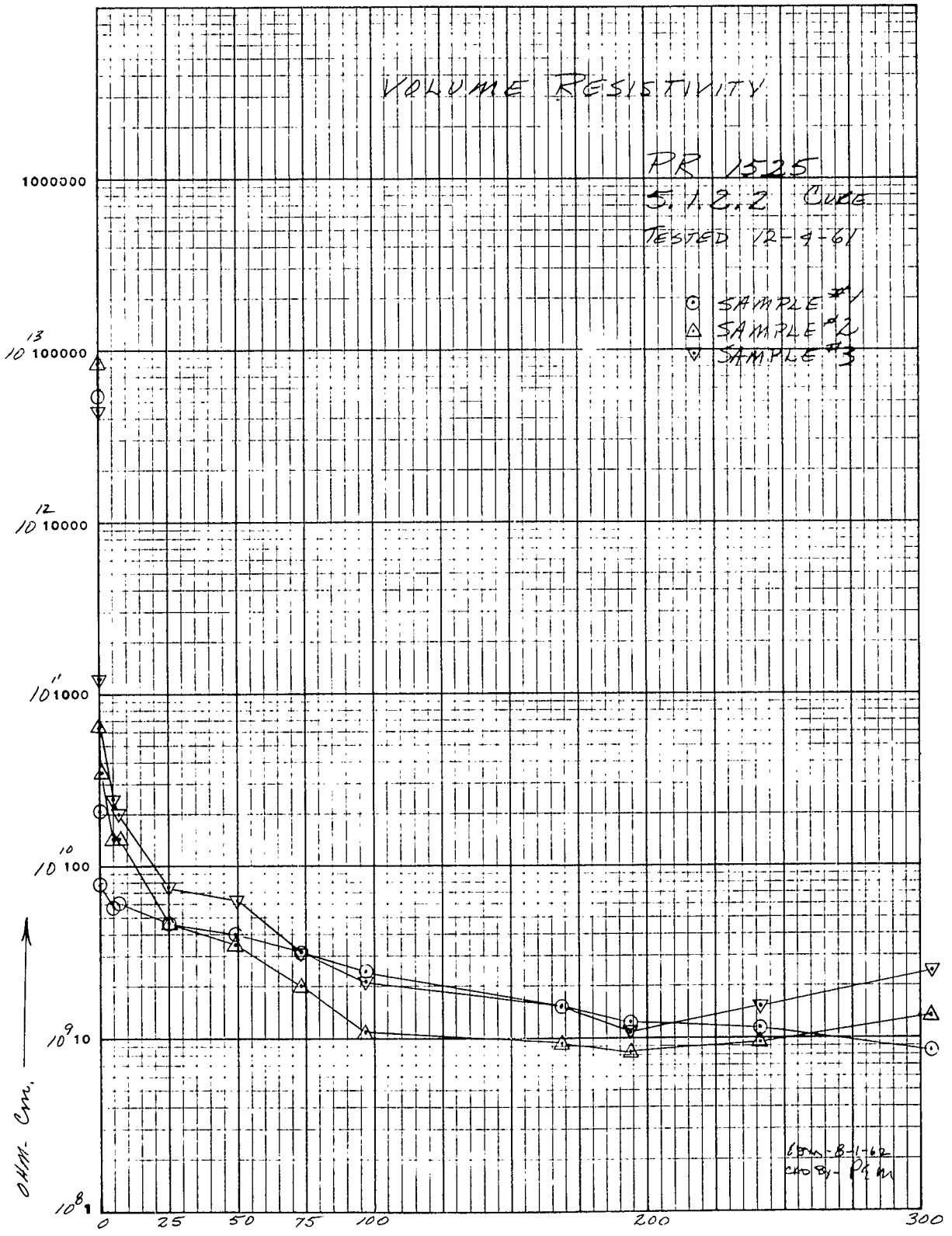
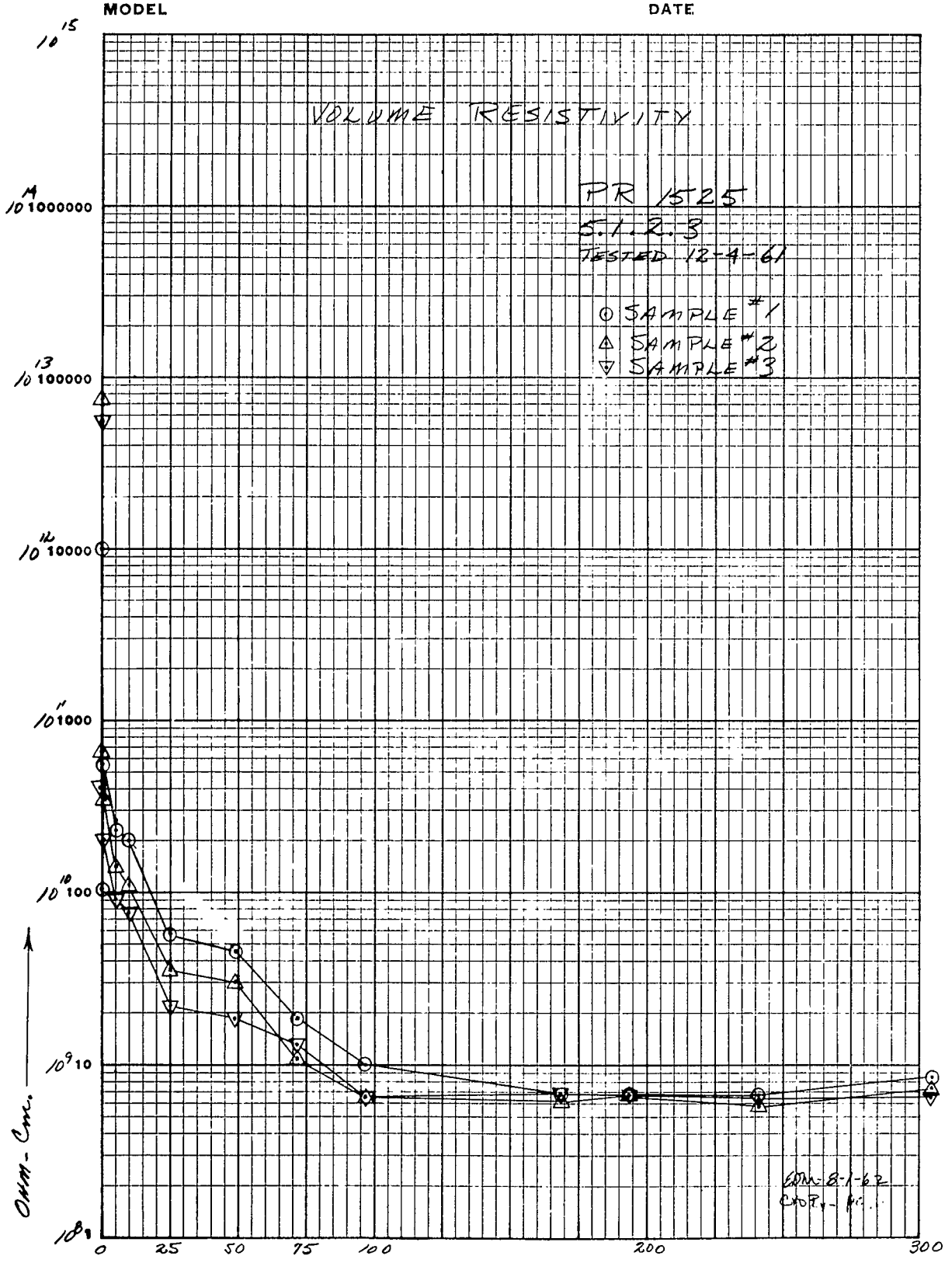
MODEL

DATE

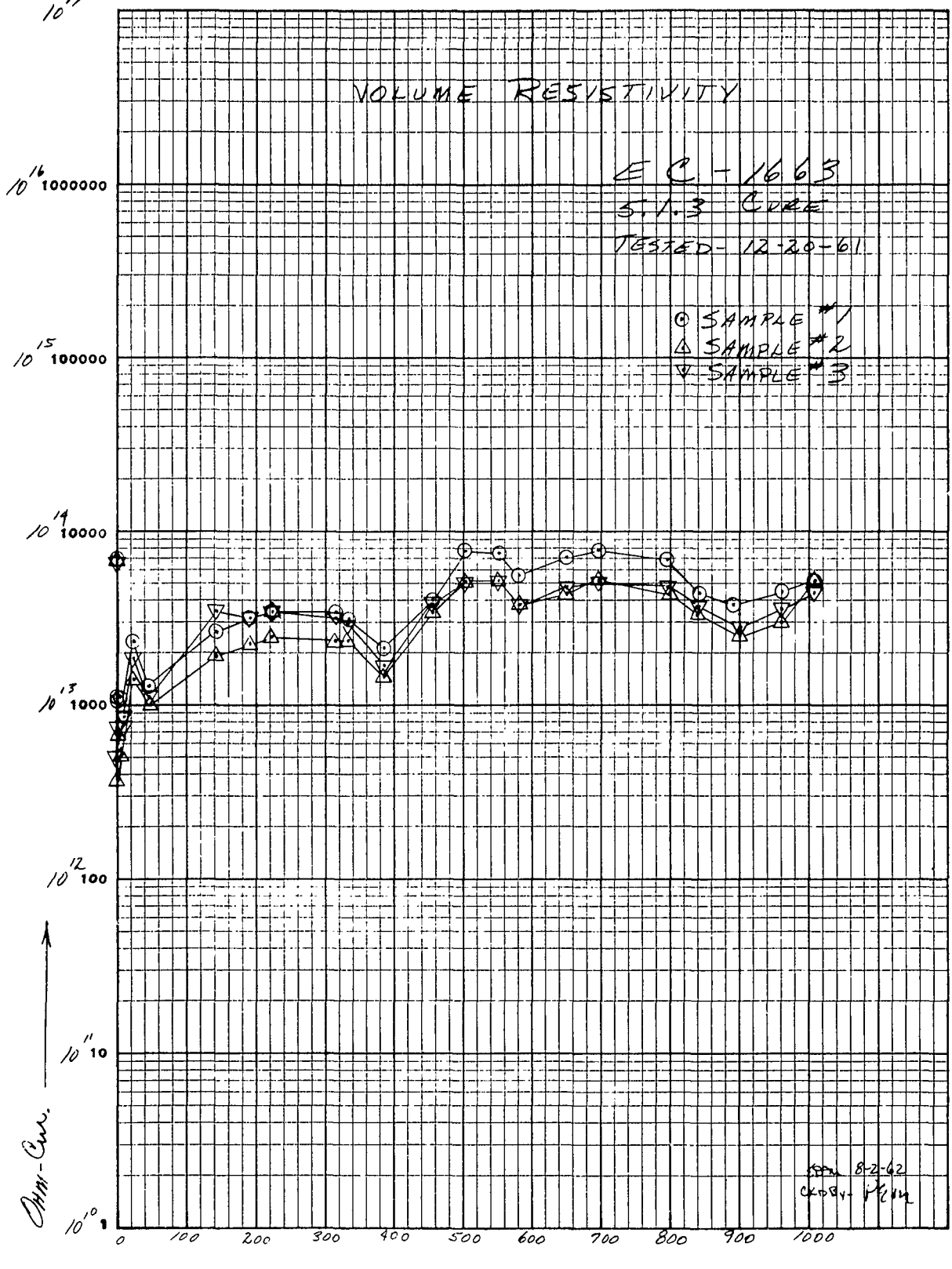


MODEL DATE



HOURS AT 300°F ⟶

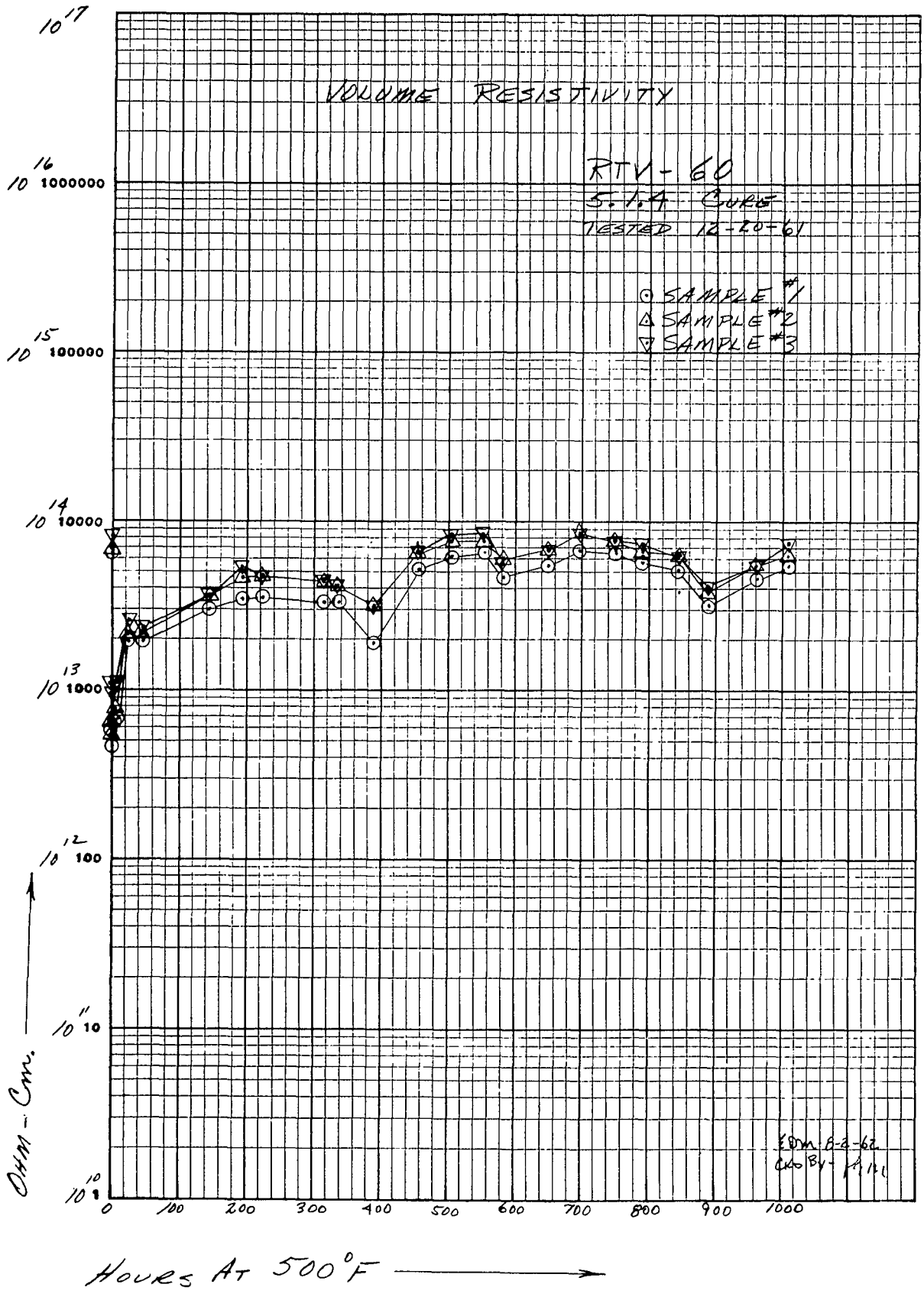
MODEL DATE



HOURS AT 500°F ——————→

MODEL

DATE


VOLUME RESISTIVITY
RTV-60
5.1.4 CURE
TESTED 12-20-61
SAMPLE #1
SAMPLE #2
SAMPLE #3
10^17
10^16 1000000
10^15 100000
10^14 10000
10^13 1000
10^12 100
10^11 10
10^10 1
0
100
200
300
400
500
600
700
800
900
1000
OHM - CM.
HOURS AT 500°F
EDM 8-2-62
CKD BY-

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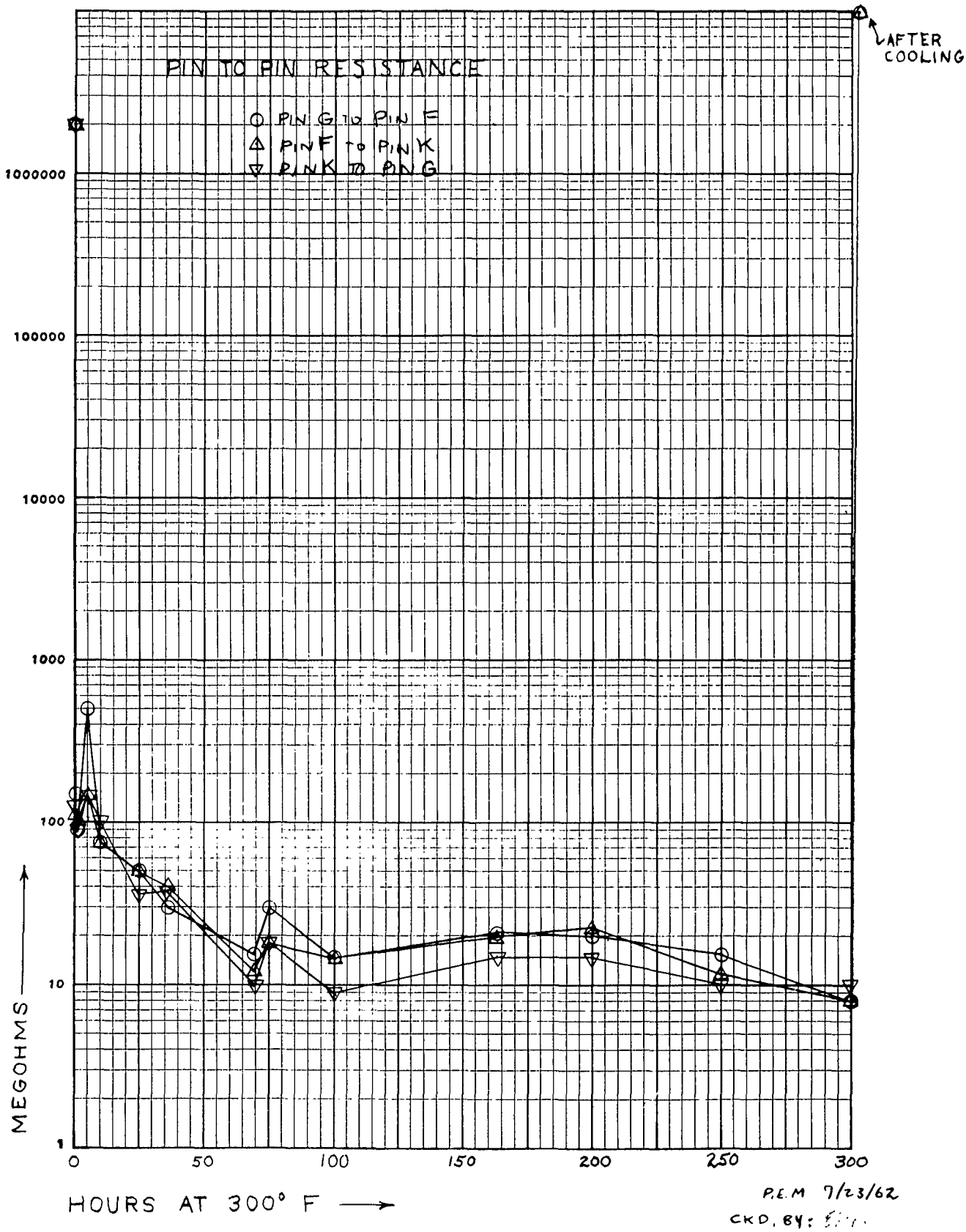
BENDIX CONNECTOR

MODEL CONTROL SAMPLE (NO POTTING) DATE TEST STARTED 3/2/62



P.E.M 7/23/62
CKD. BY:

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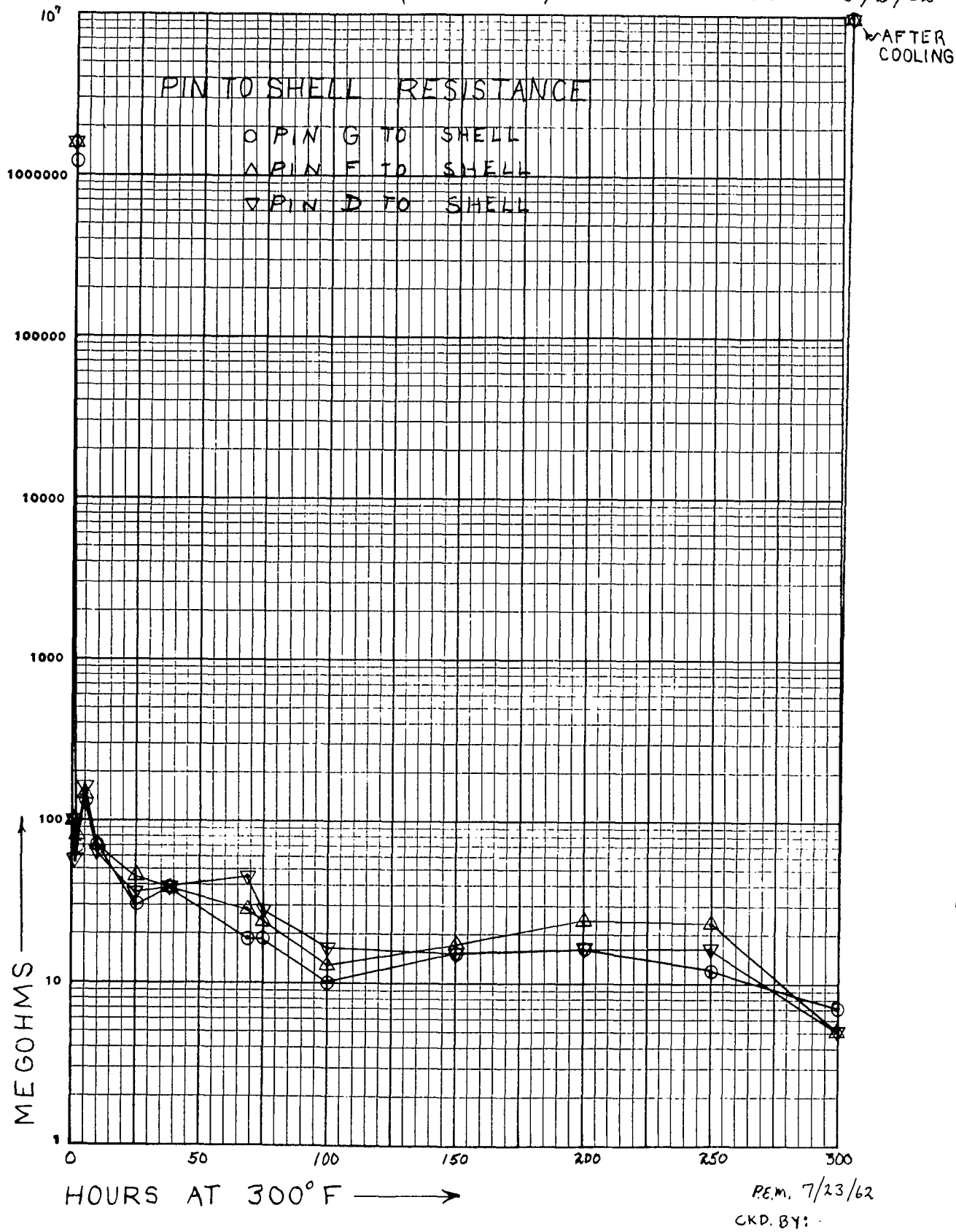
BENDIX CONNECTOR

MODEL CONTROL SAMPLE (NO POTTING) DATE TEST STARTED 3/2/62



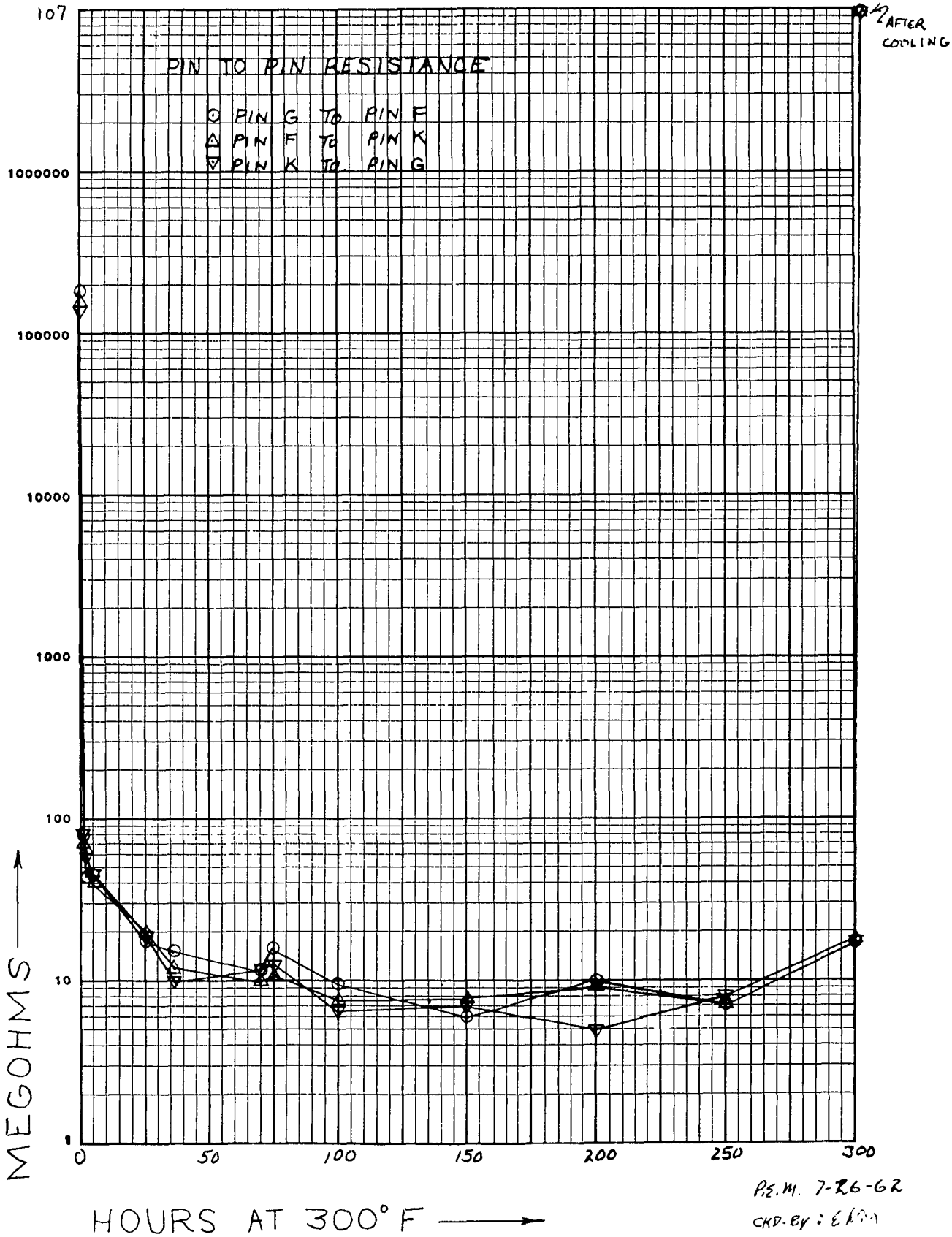
P.E.M. 7/23/62

CKD. BY:

BENDIX CONNECTOR

MODEL PROSEAL 777 5.2.1 CURE

DATE TEST STARTED 3-2-62



P.E.M. 7-26-62

CKD. BY : E.M.

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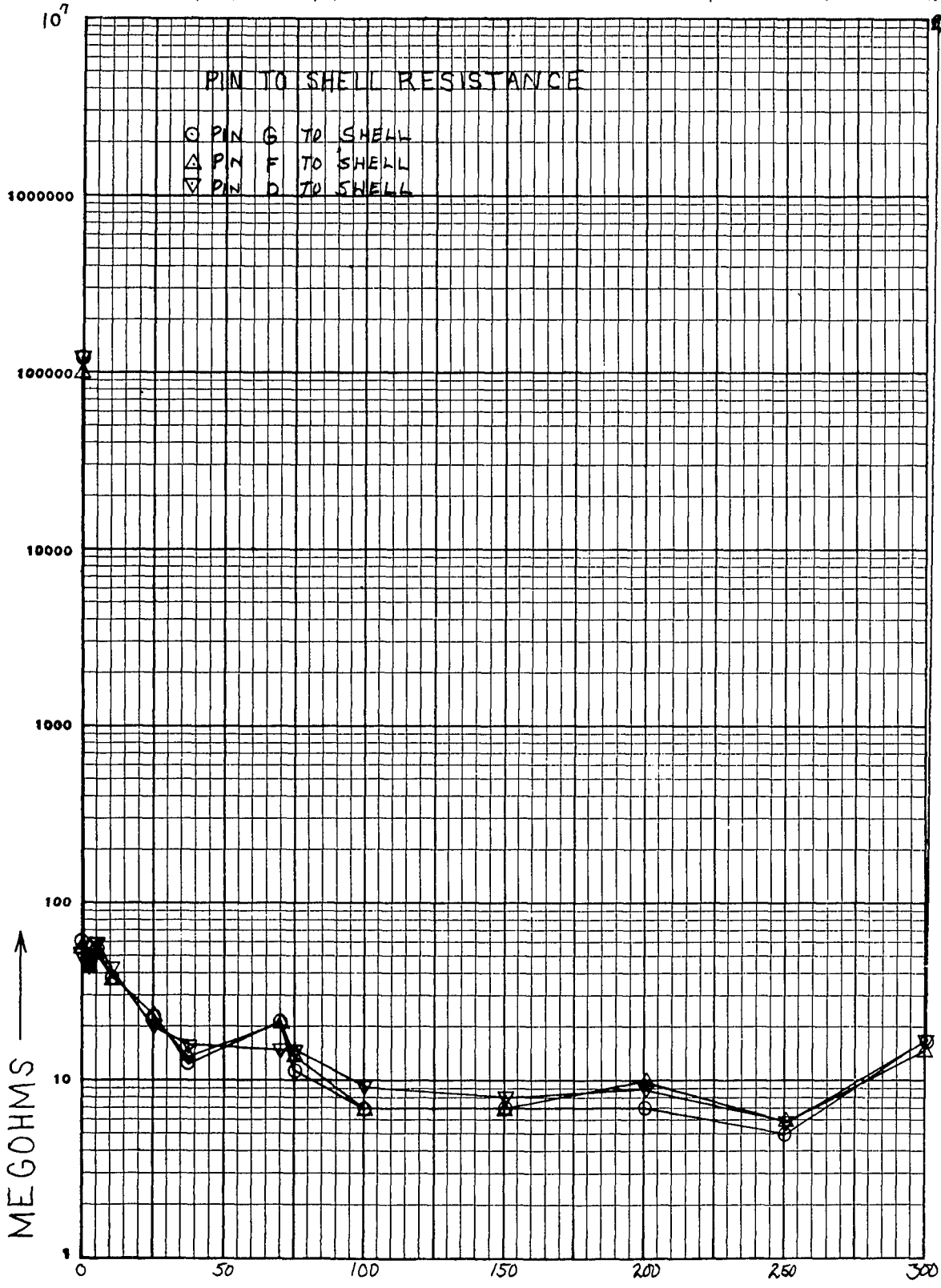
BENDIX CONNECTOR

MODEL PROSEAL 777 5.2.1 CURE

DATE TEST STARTED 3-2-62



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CKD. BY: EBM

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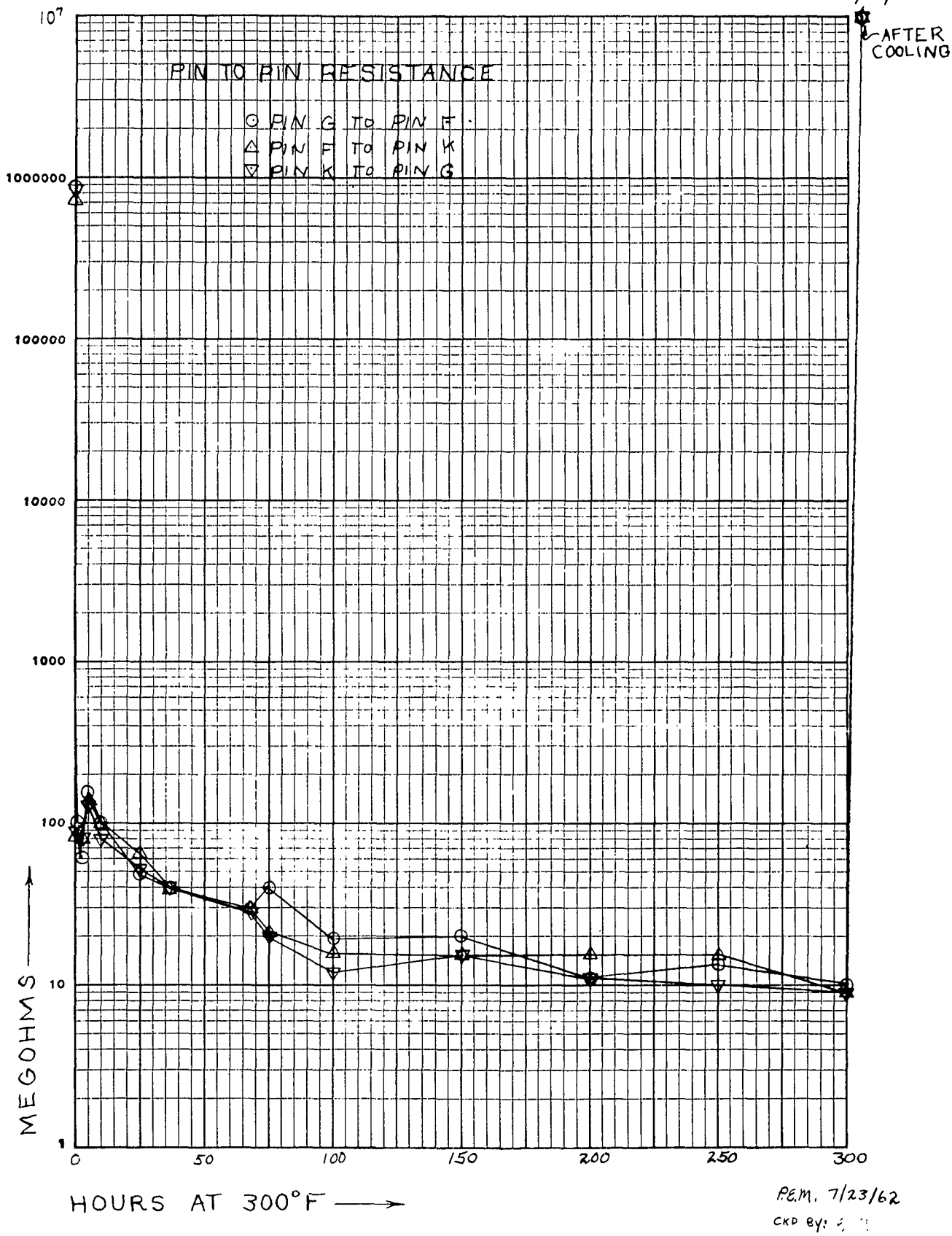
BENDIX CONNECTOR

MODEL PR-1525 5.2.2 CURE

DATE TEST STARTED 3/2/62



P.E.M. 7/23/62

CKD BY:

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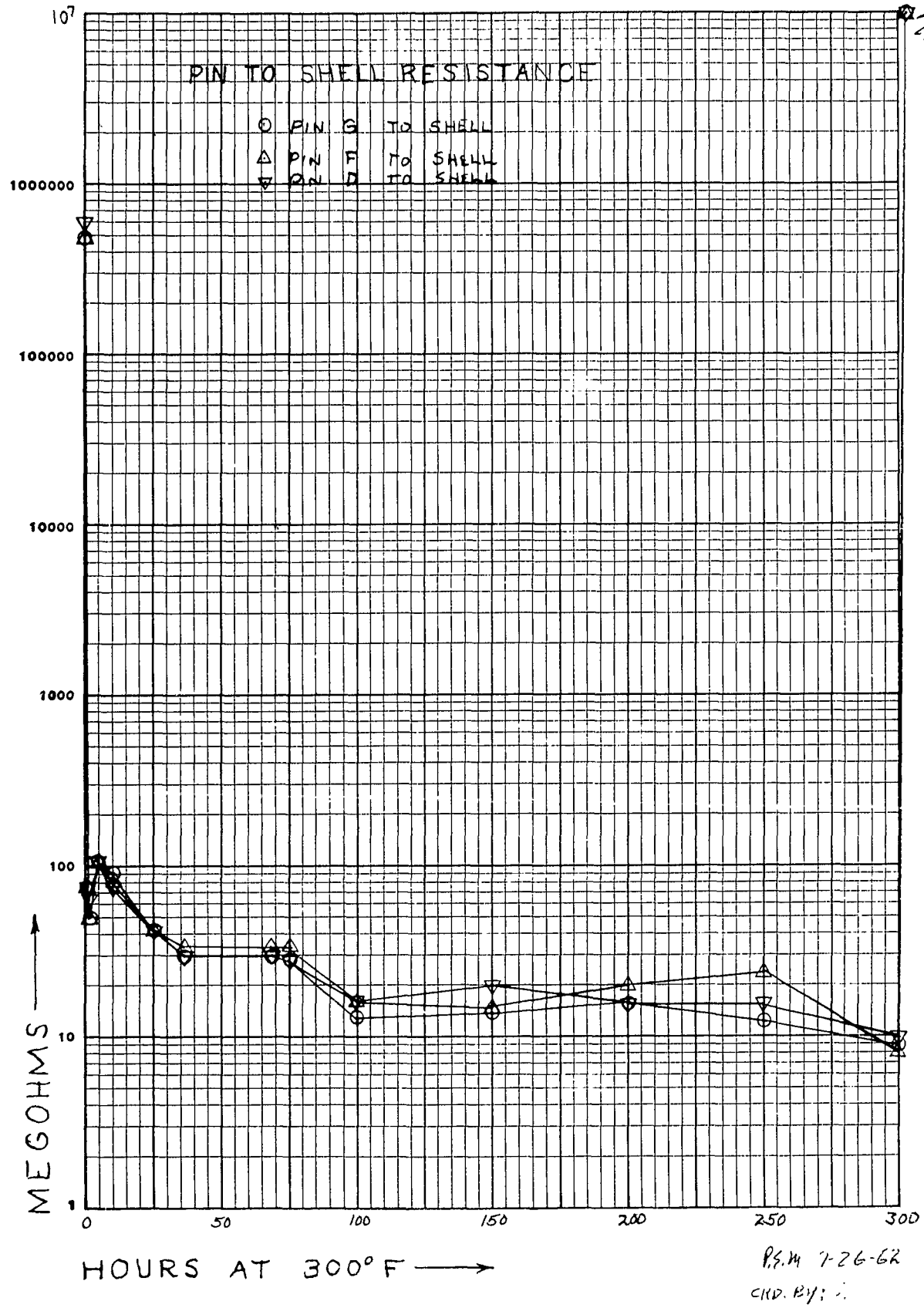
BENDIX CONNECTOR

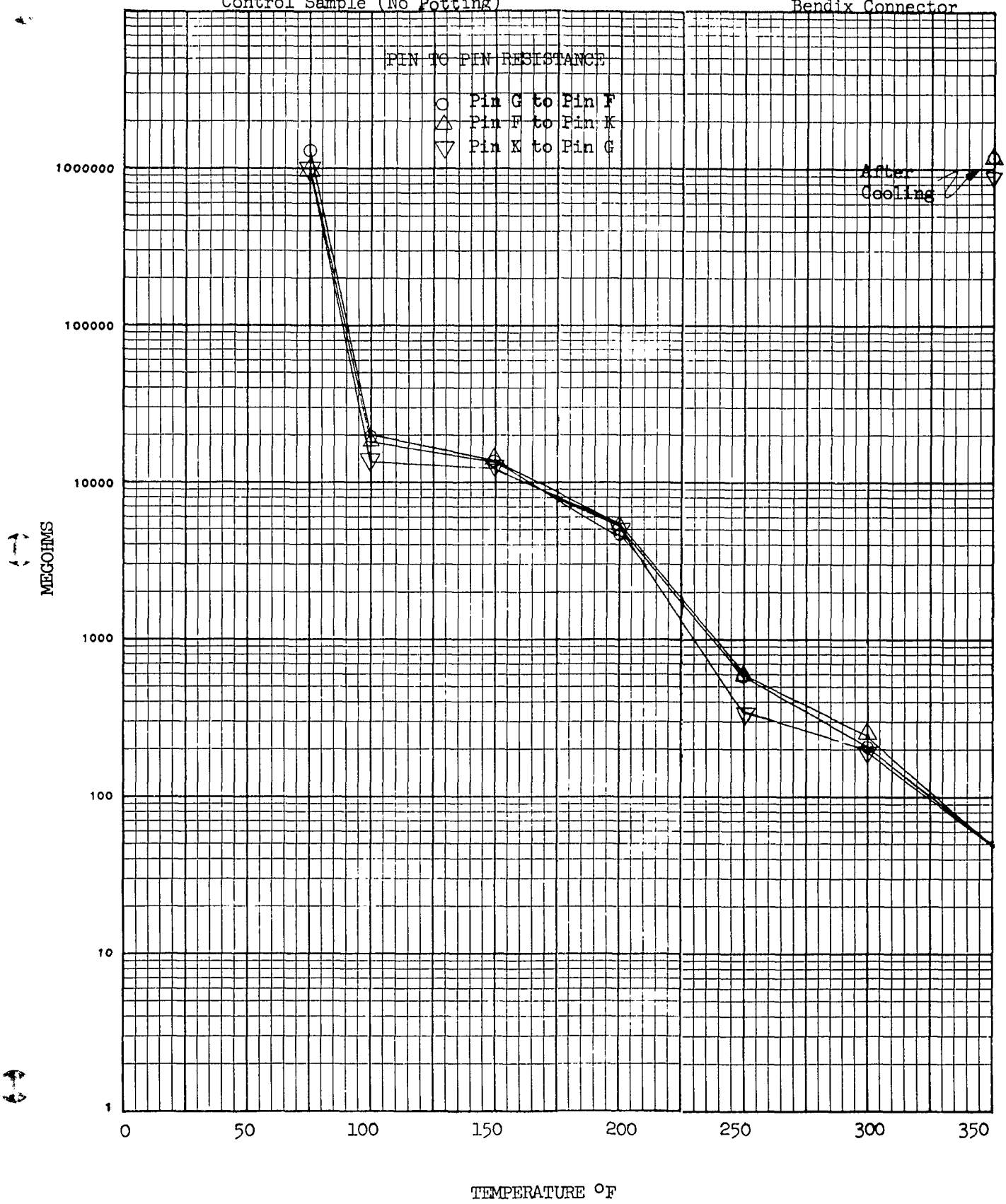
MODEL PR-1525 5.2.2. CURE

DATE TEST STARTED 3/2/62

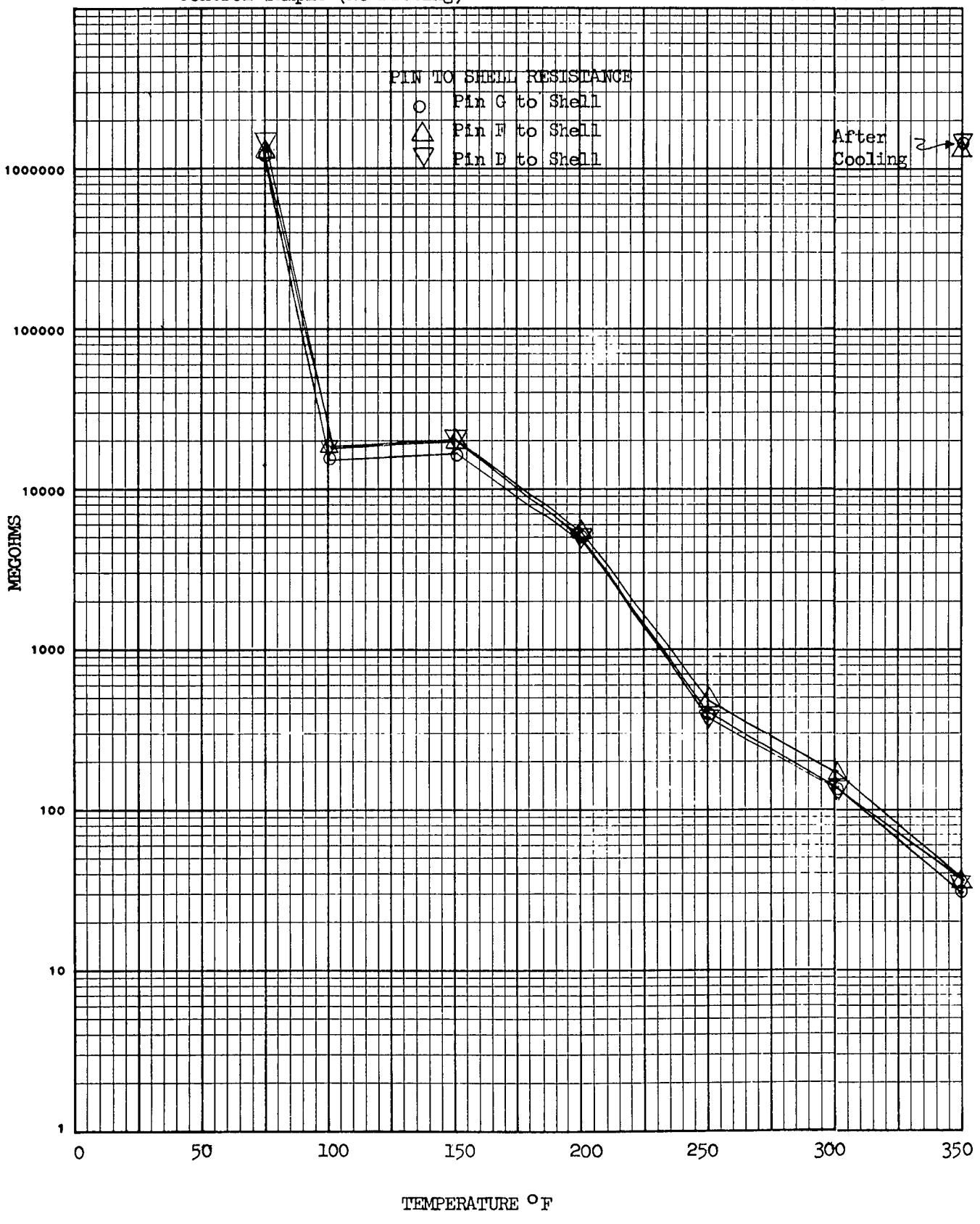


P.S.M 7-26-62
CHD. BY:

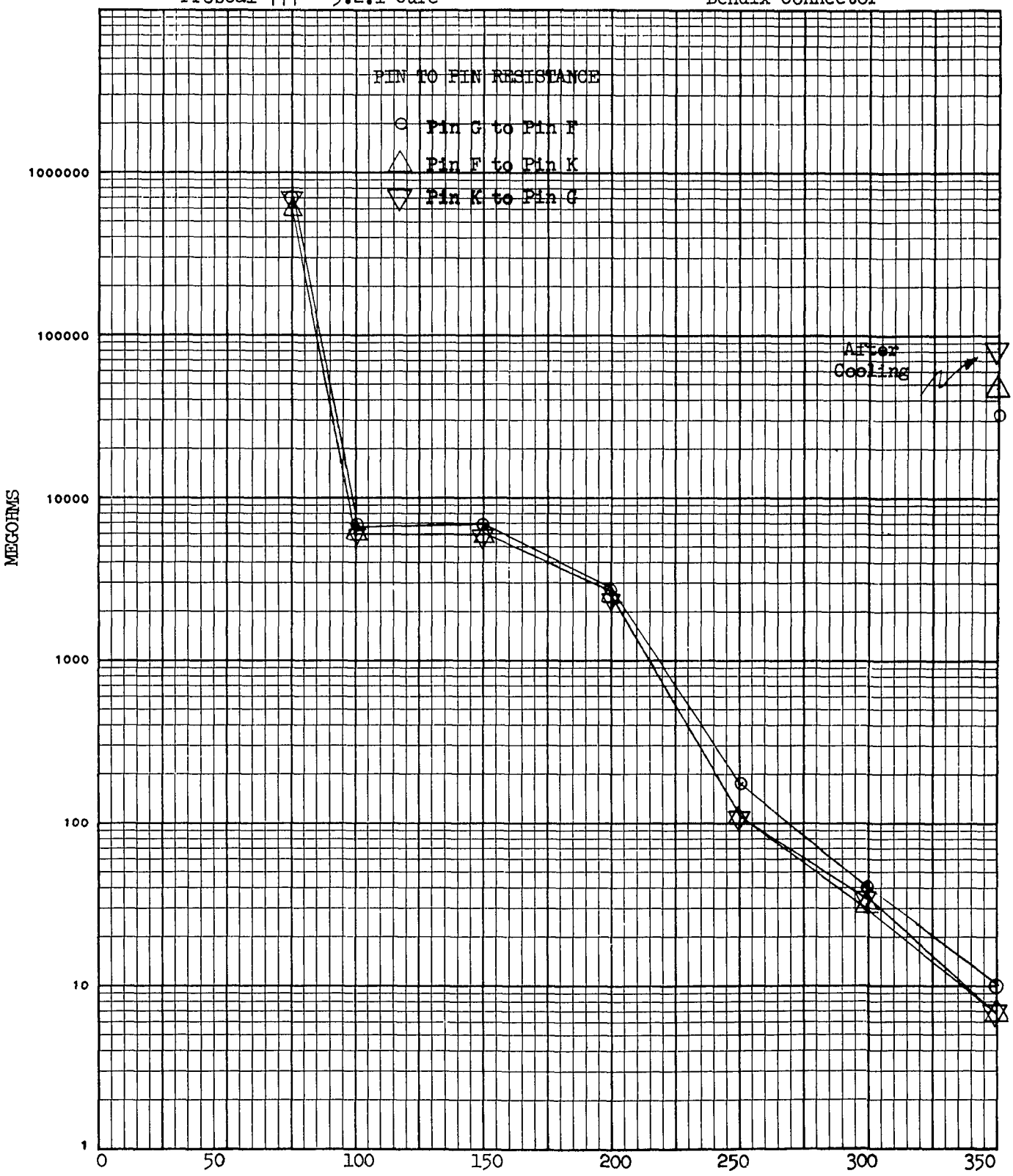
MODEL Control Sample (No Potting) DATE Bendix Connector



MODEL Control Sample (No Potting) DATE Bendix Connector

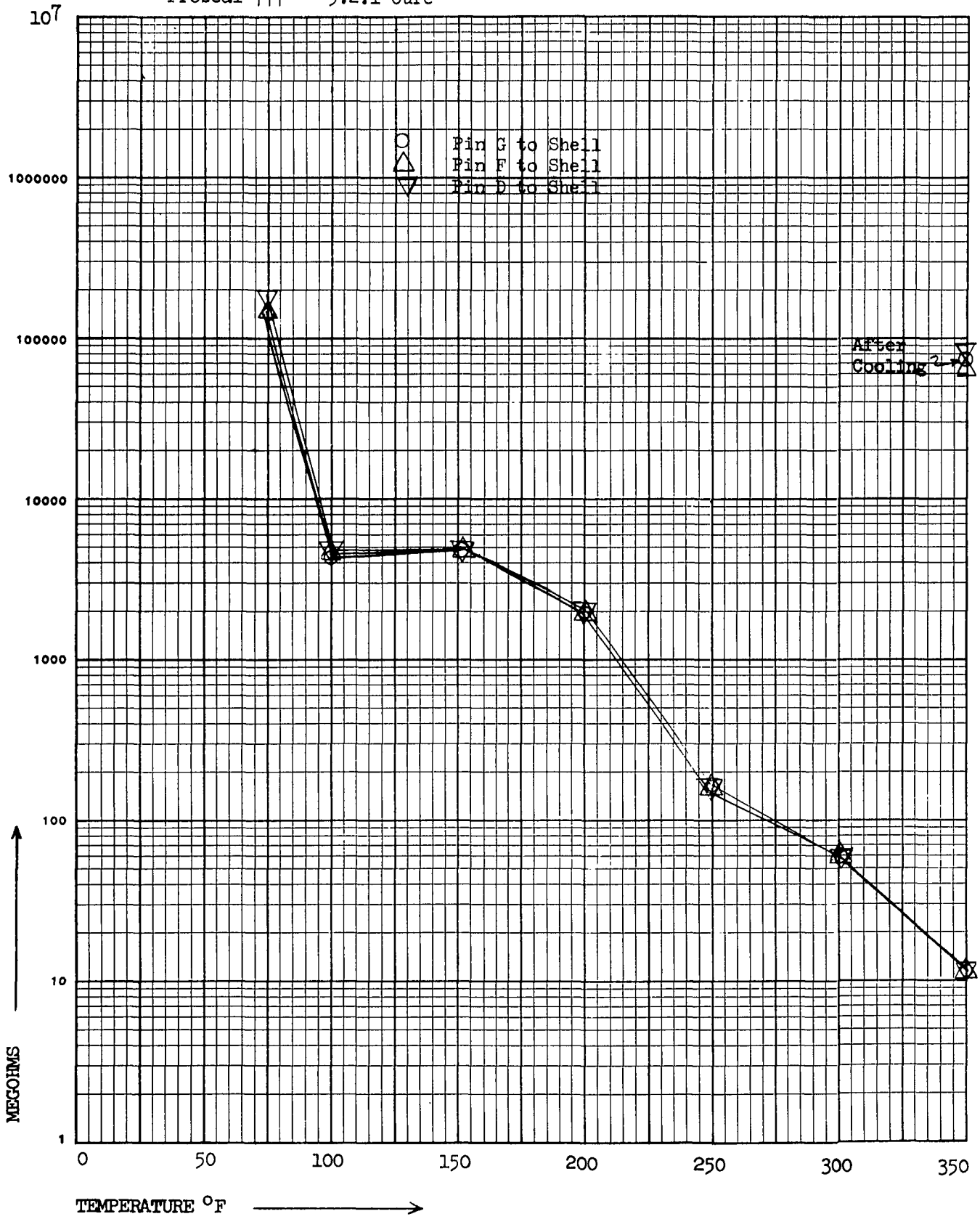


MODEL Proseal 777 5.2.1 Cure DATE Bendix Connector

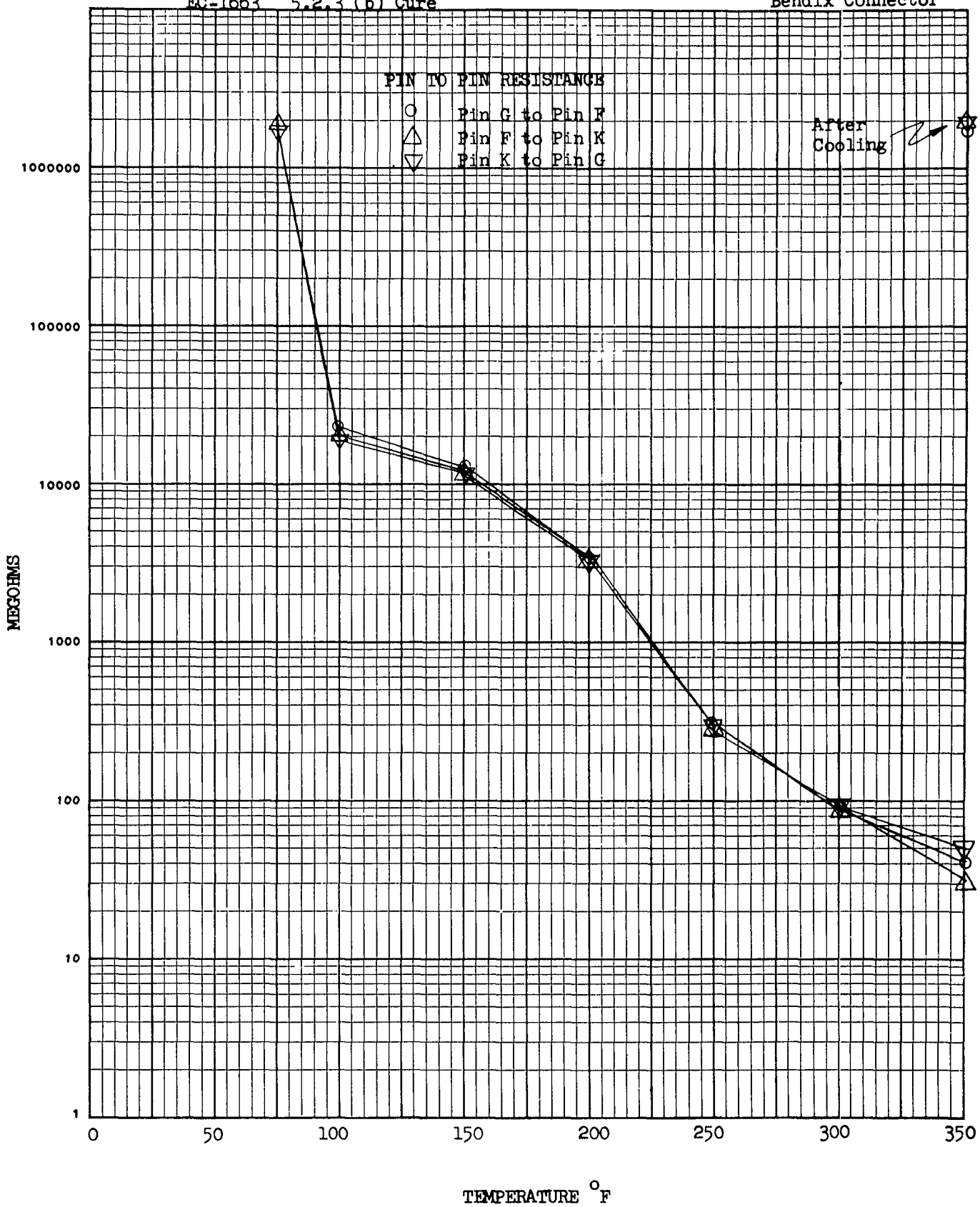


Bendix Connector

MODEL Proseal 777 5.2.1 Cure DATE



MODEL EC-1663 5.2.3 (b) Cure DATE Bendix Connector



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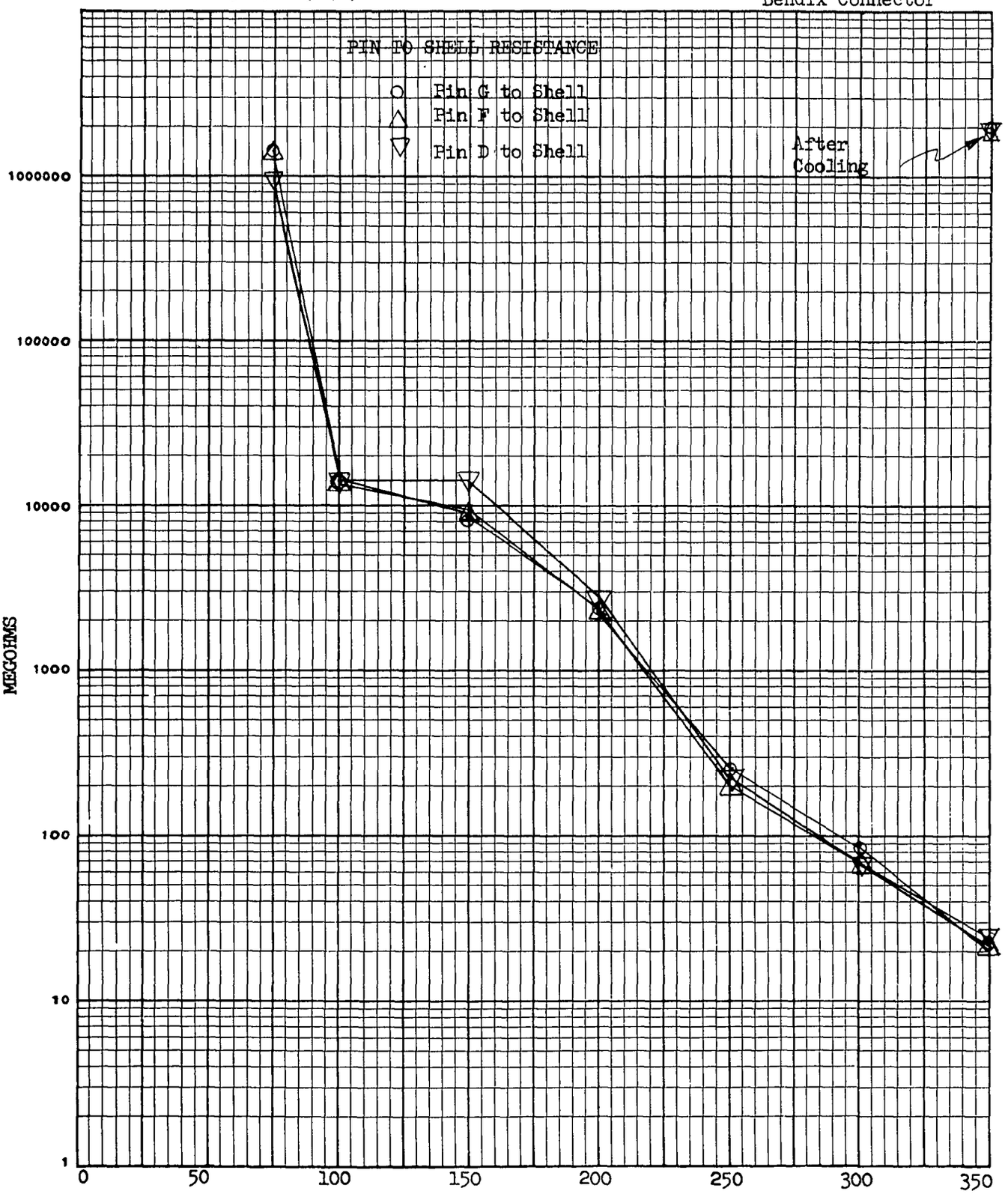
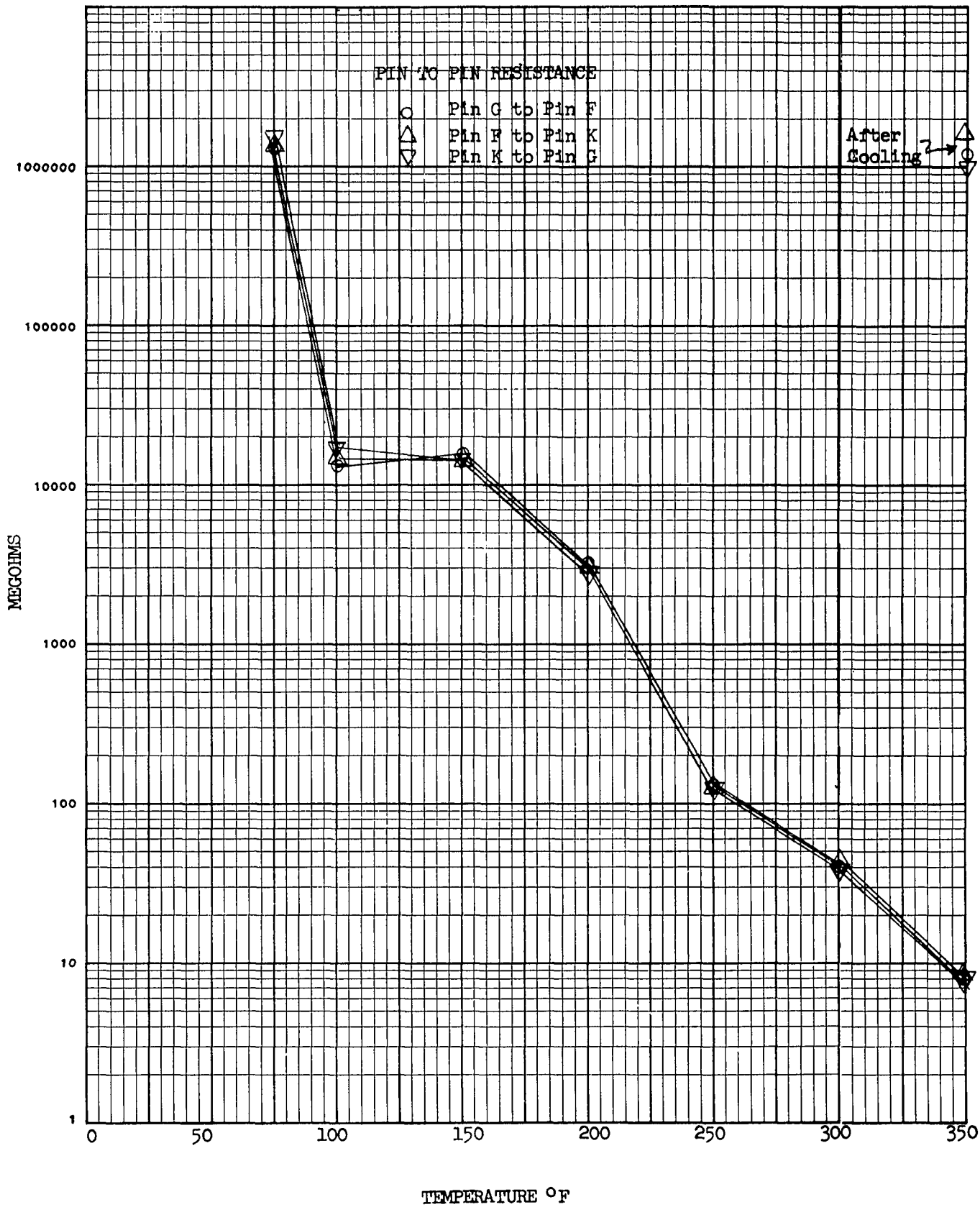
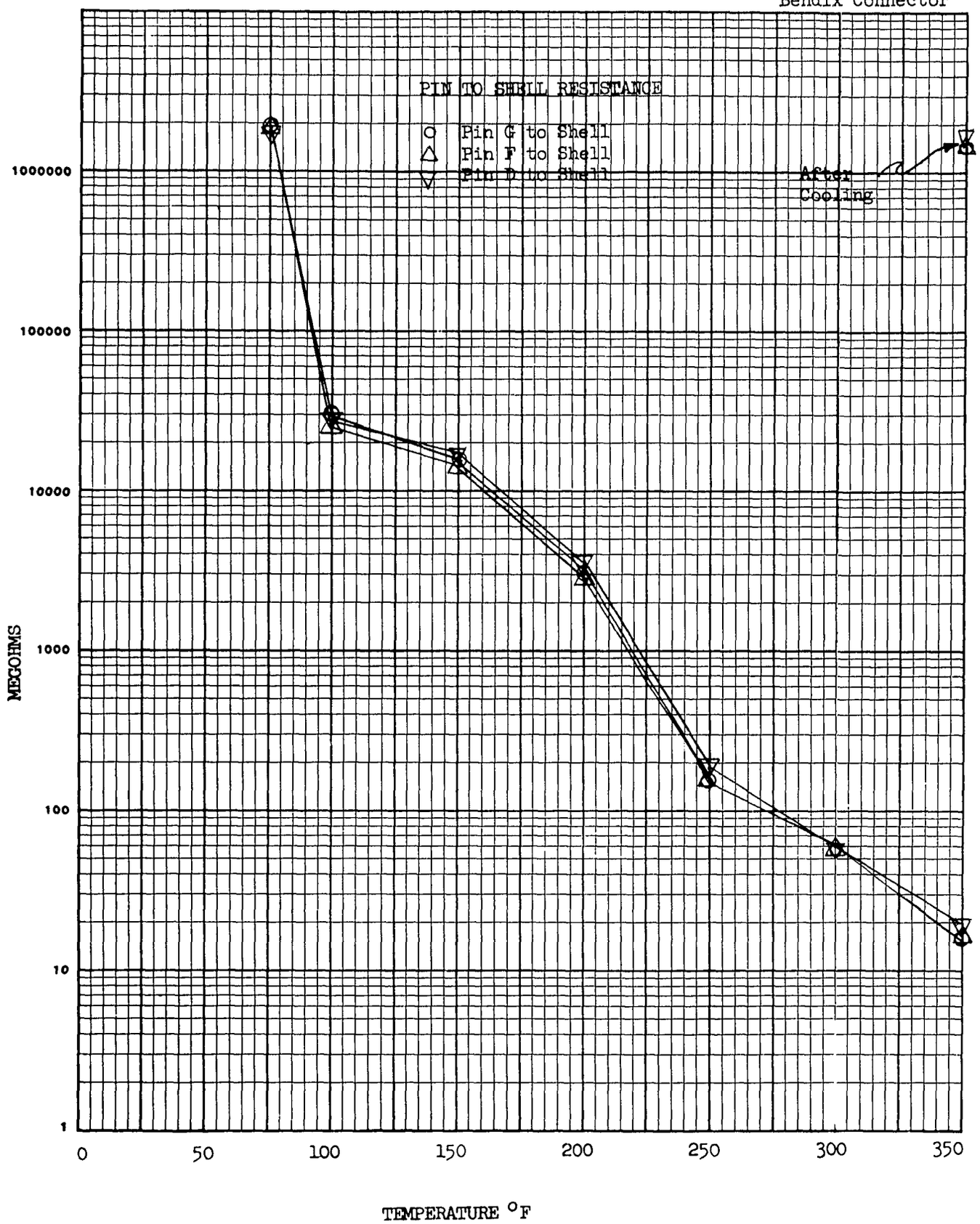


MODEL EC-1663 5.2.3(a) Cure DATE Bendix Connector

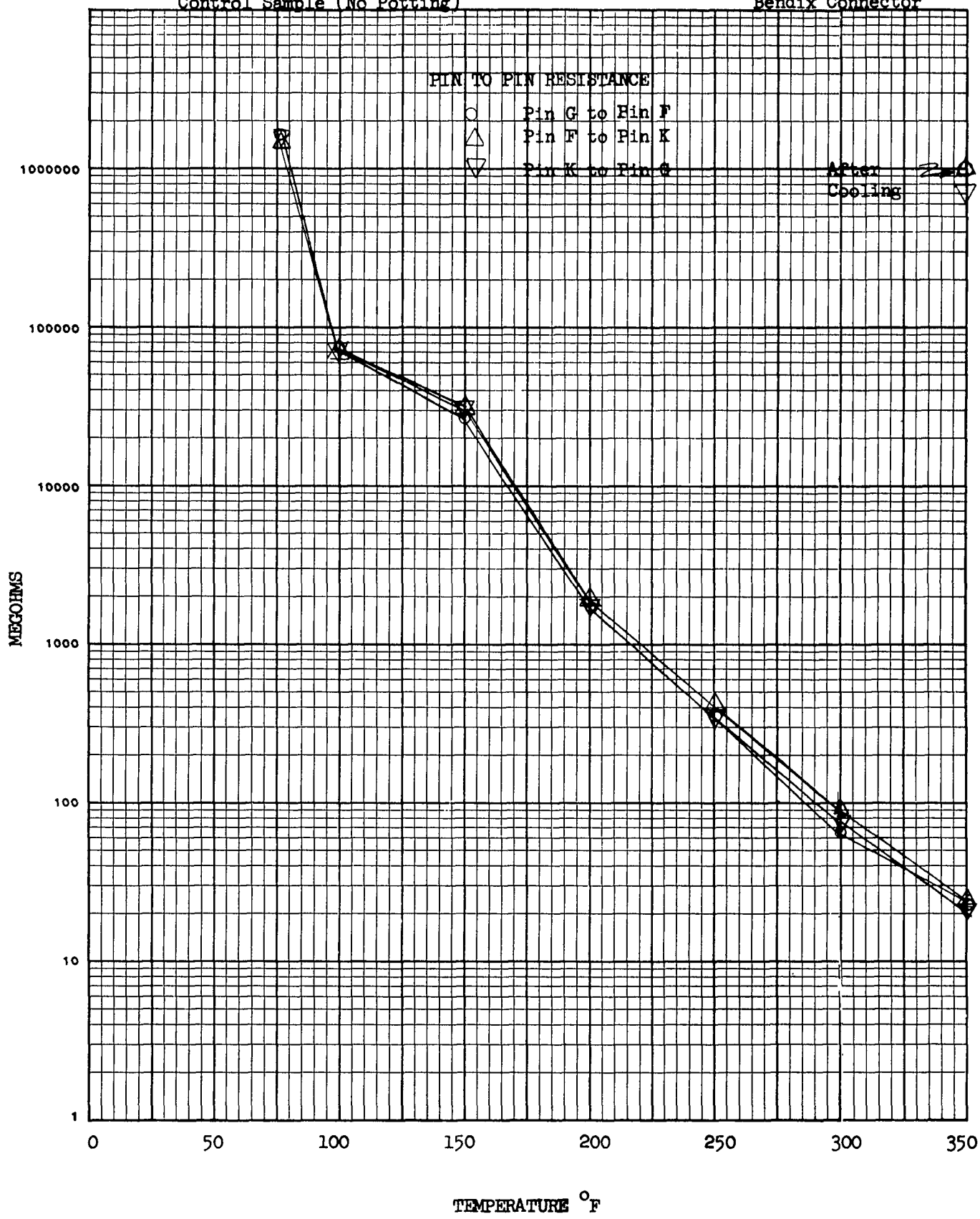


MODEL EC-1663 5.2.3 (a) Cure DATE

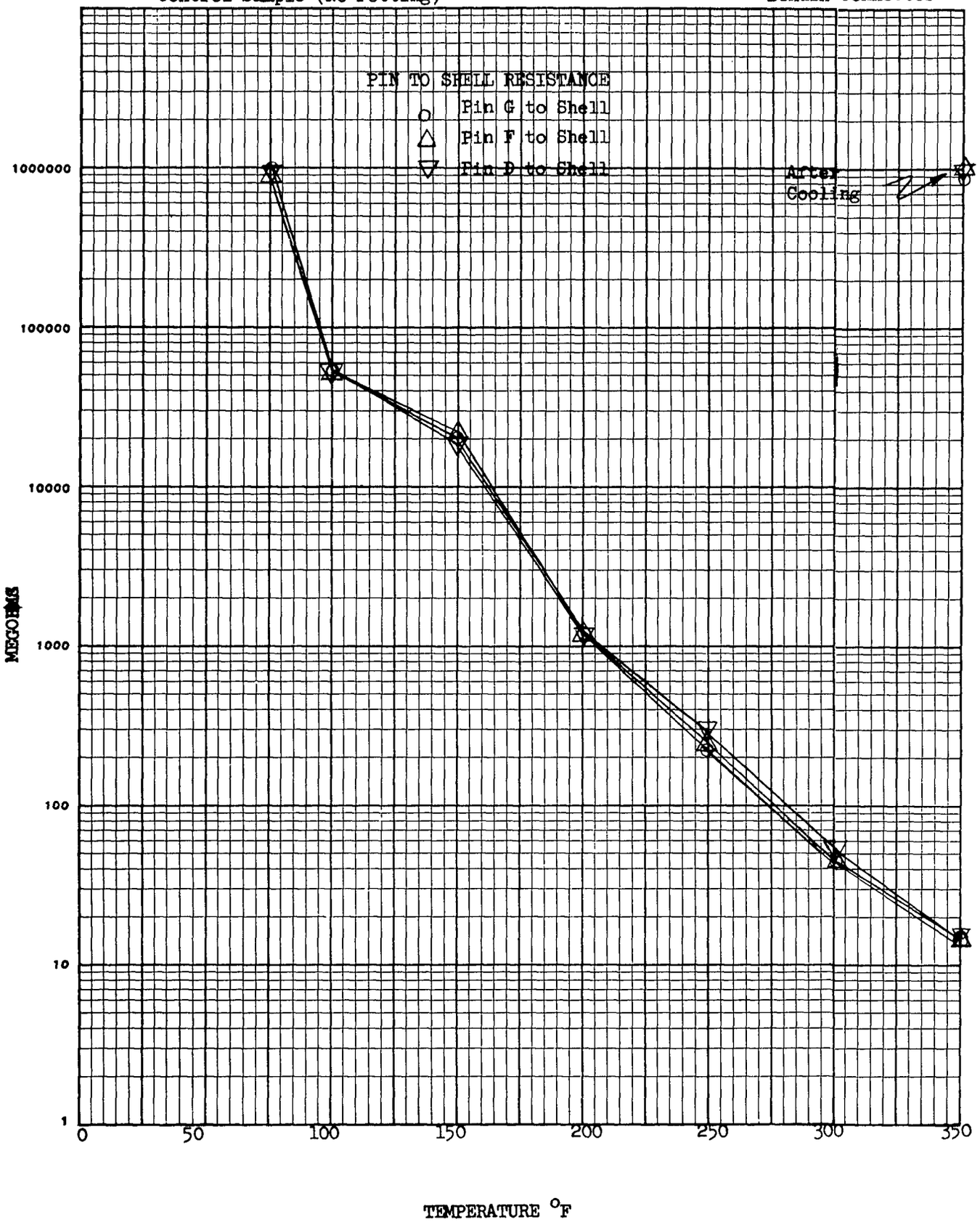
Bendix Connector



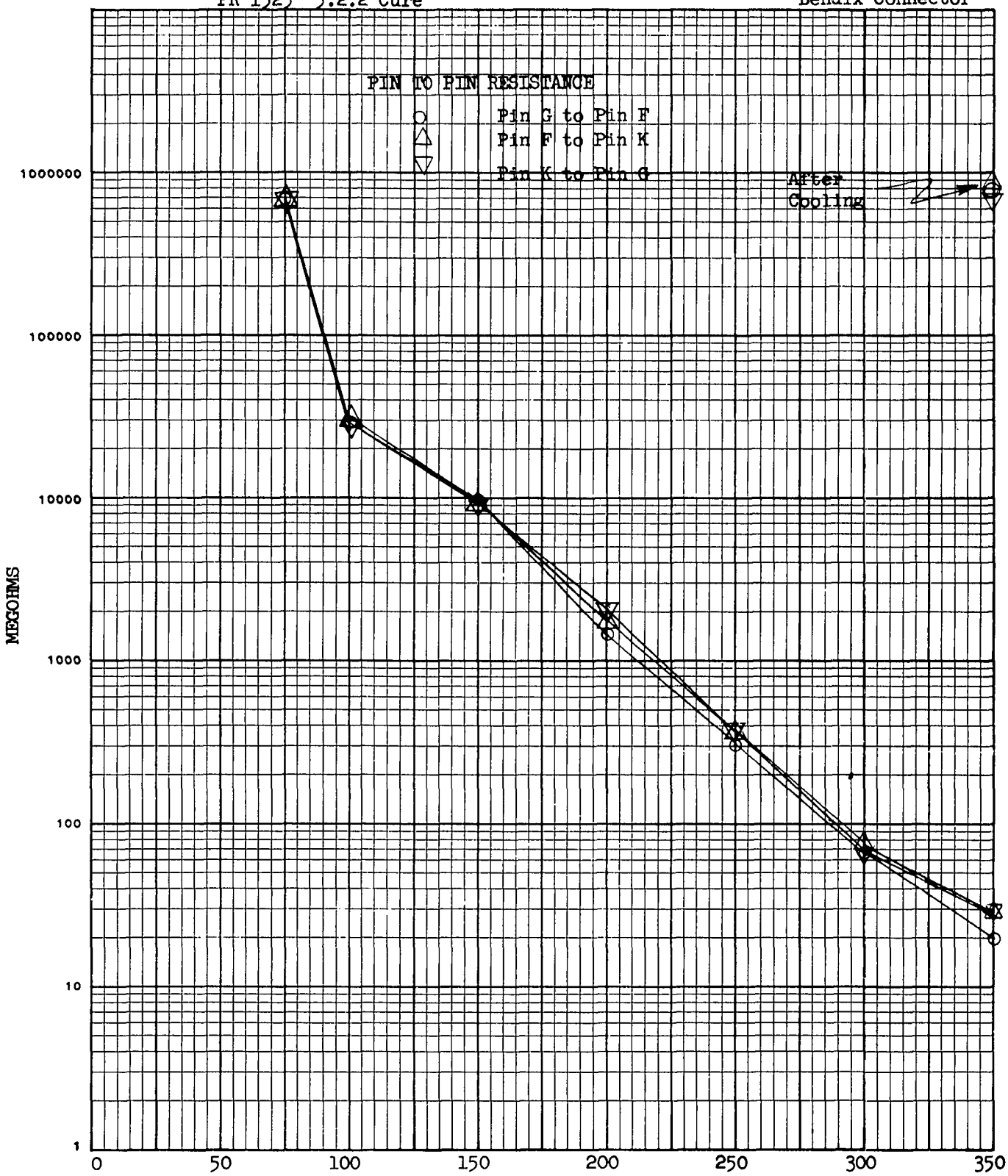
MODEL Control Sample (No Potting) DATE Bendix Connector



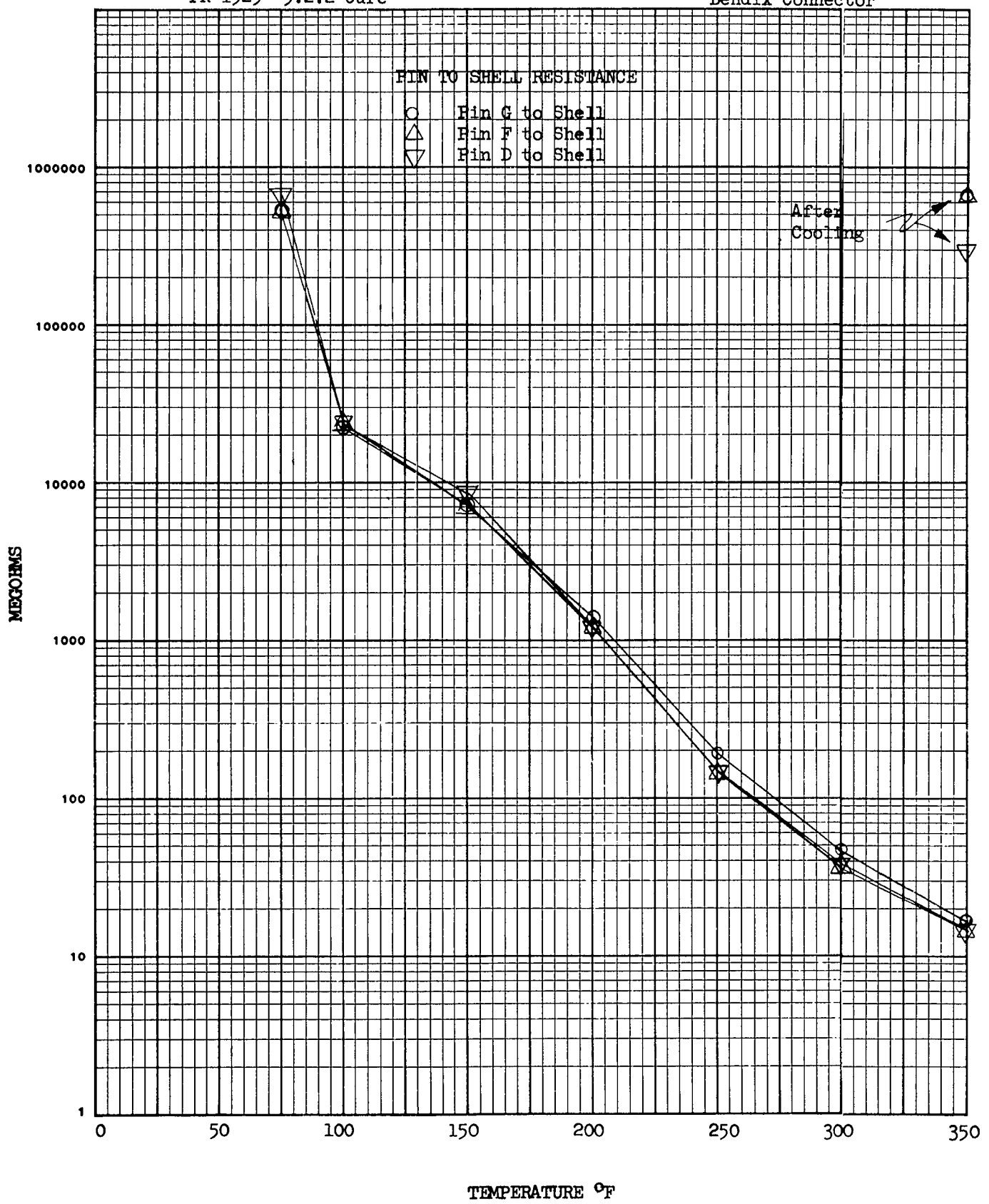
MODEL Control Sample (No Potting) DATE Bendix Connector



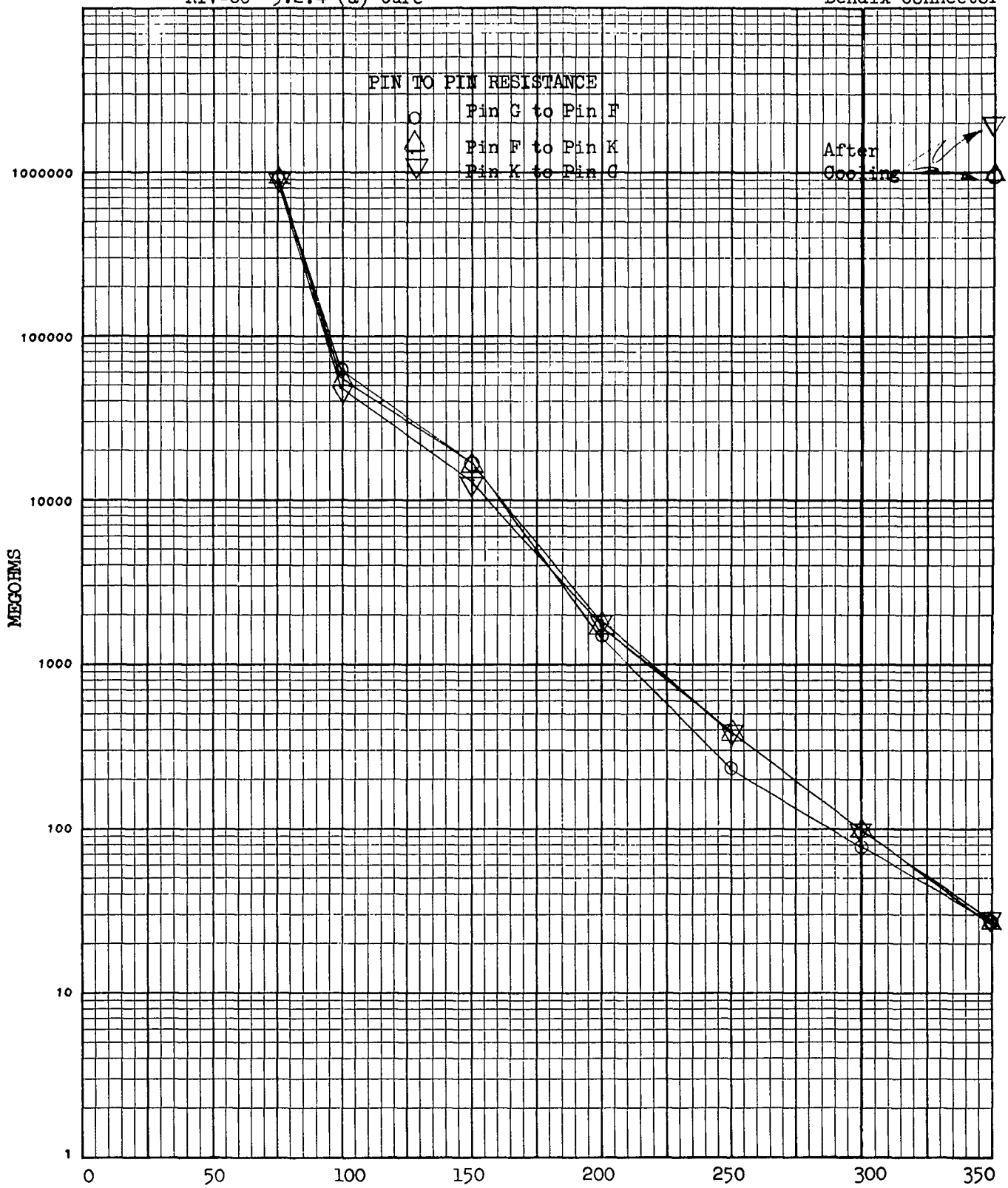
MODEL PR 1525 5.2.2 Cure DATE Bendix Connector



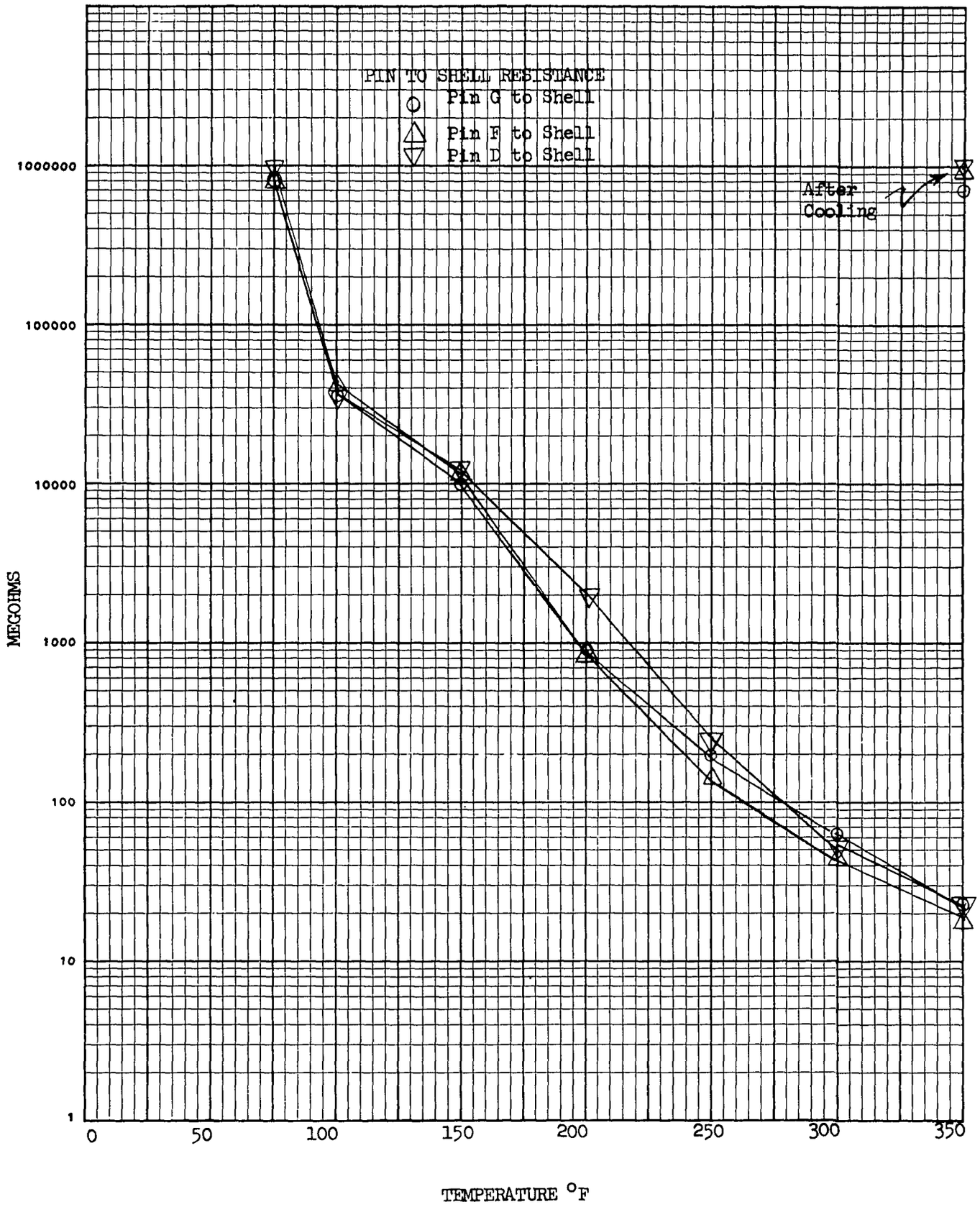
MODEL PR 1525 5.2.2 Cure DATE Bendix Connector



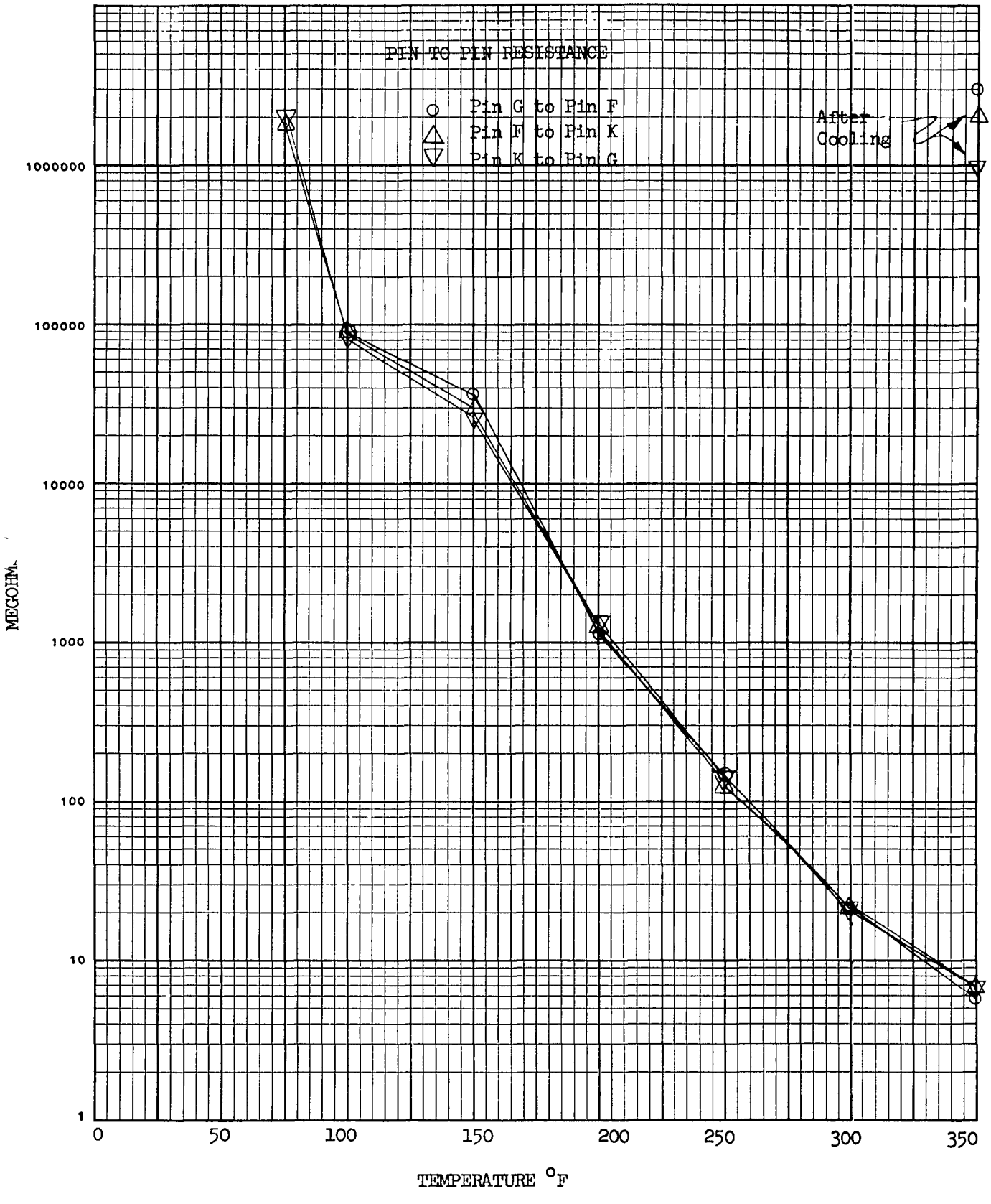
MODEL RTV-60 5.2.4 (a) Cure DATE Bendix Connector



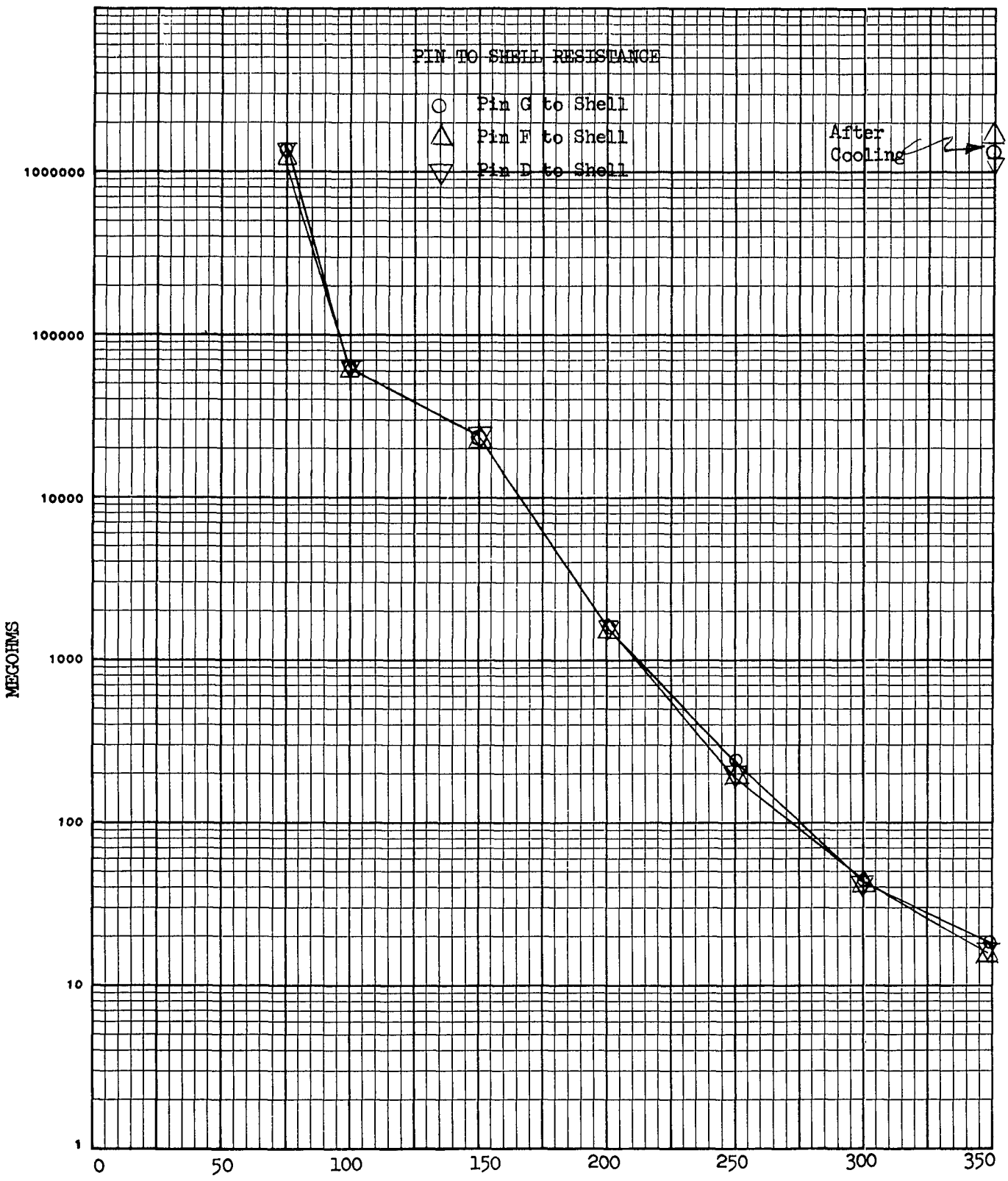
MODEL RTV-60 5.2.4 (a) Cure DATE Bendix Connector



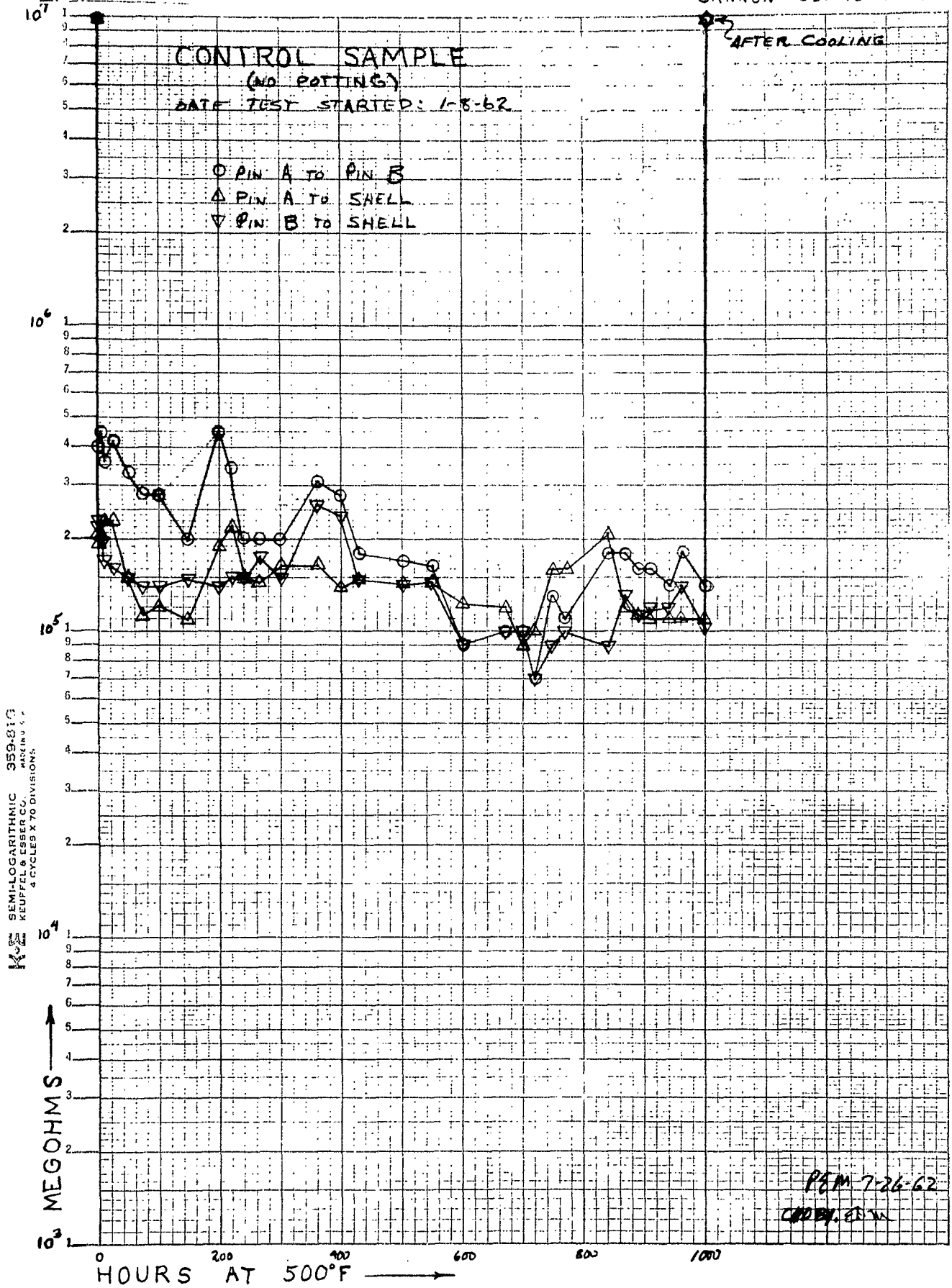
MODEL RTV-60 5.2.4 (b) Cure DATE Bendix Connector



MODEL RTV-60 5.2.4 (b) Cure DATE Bendix Connector

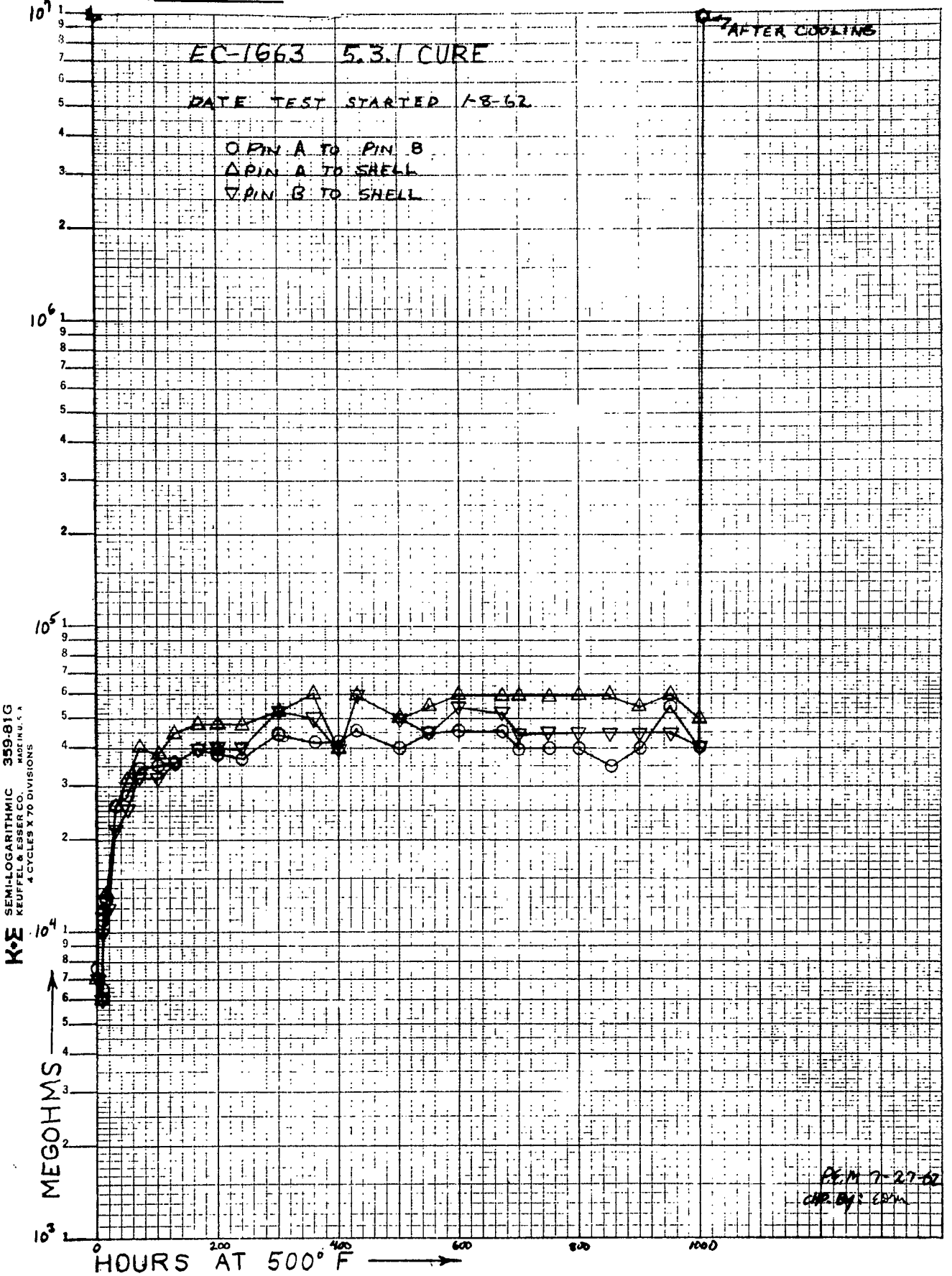


CANNON CONNECTOR



PEM 7-26-62

CANNON CONNECTOR



P.M. 7-27-62
CHK. BY: EBM

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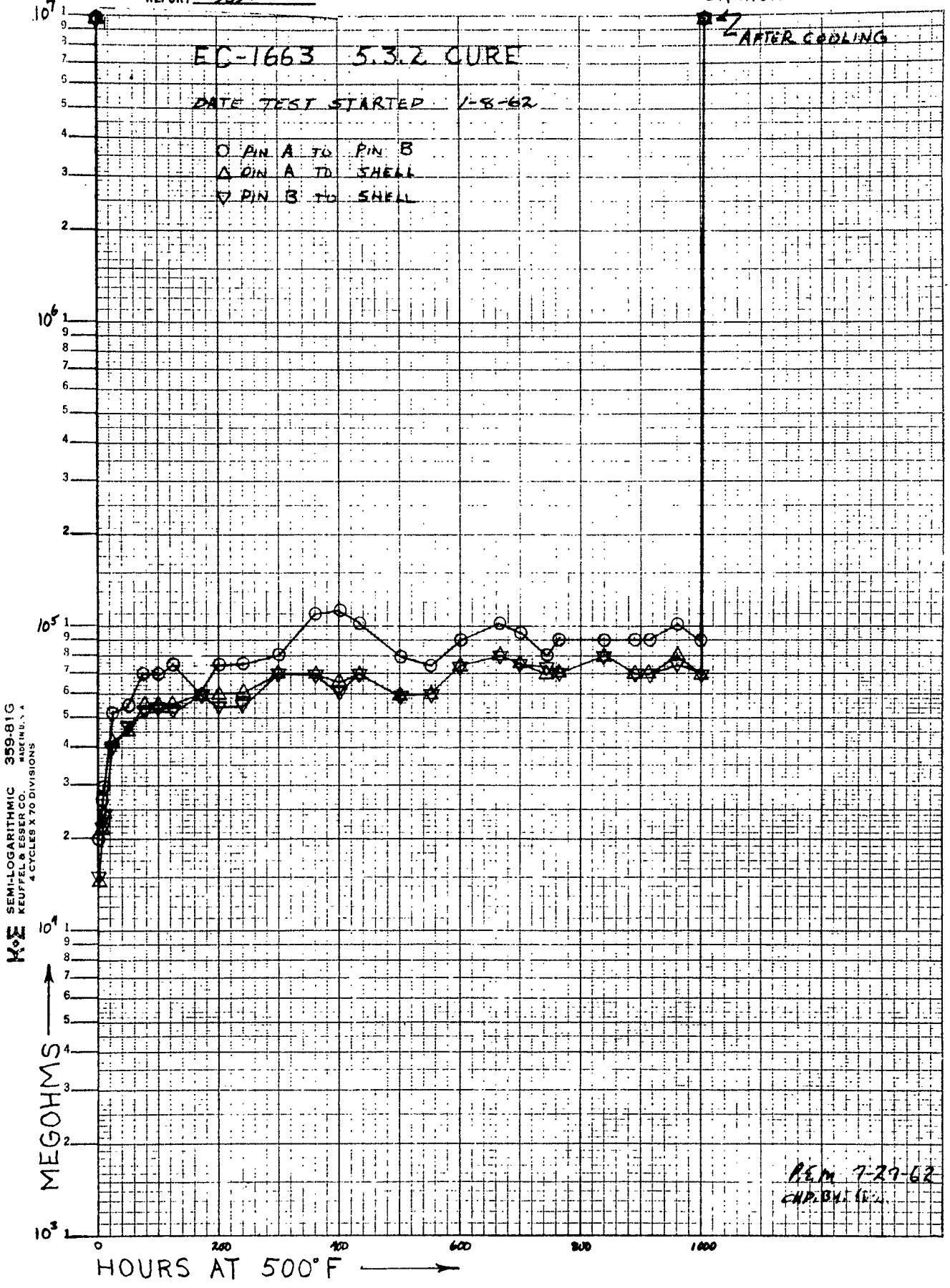
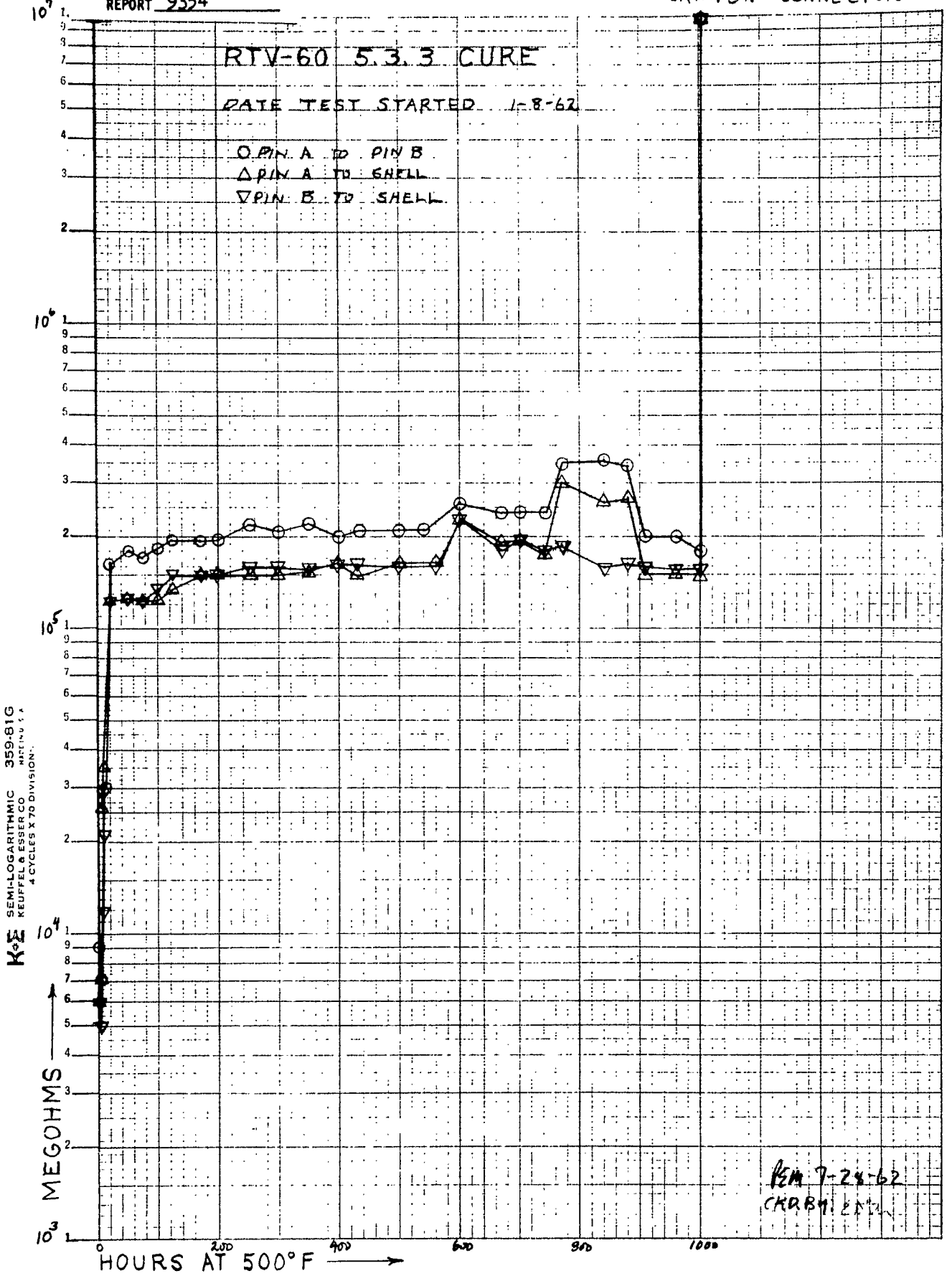
CANNON CONNECTOR



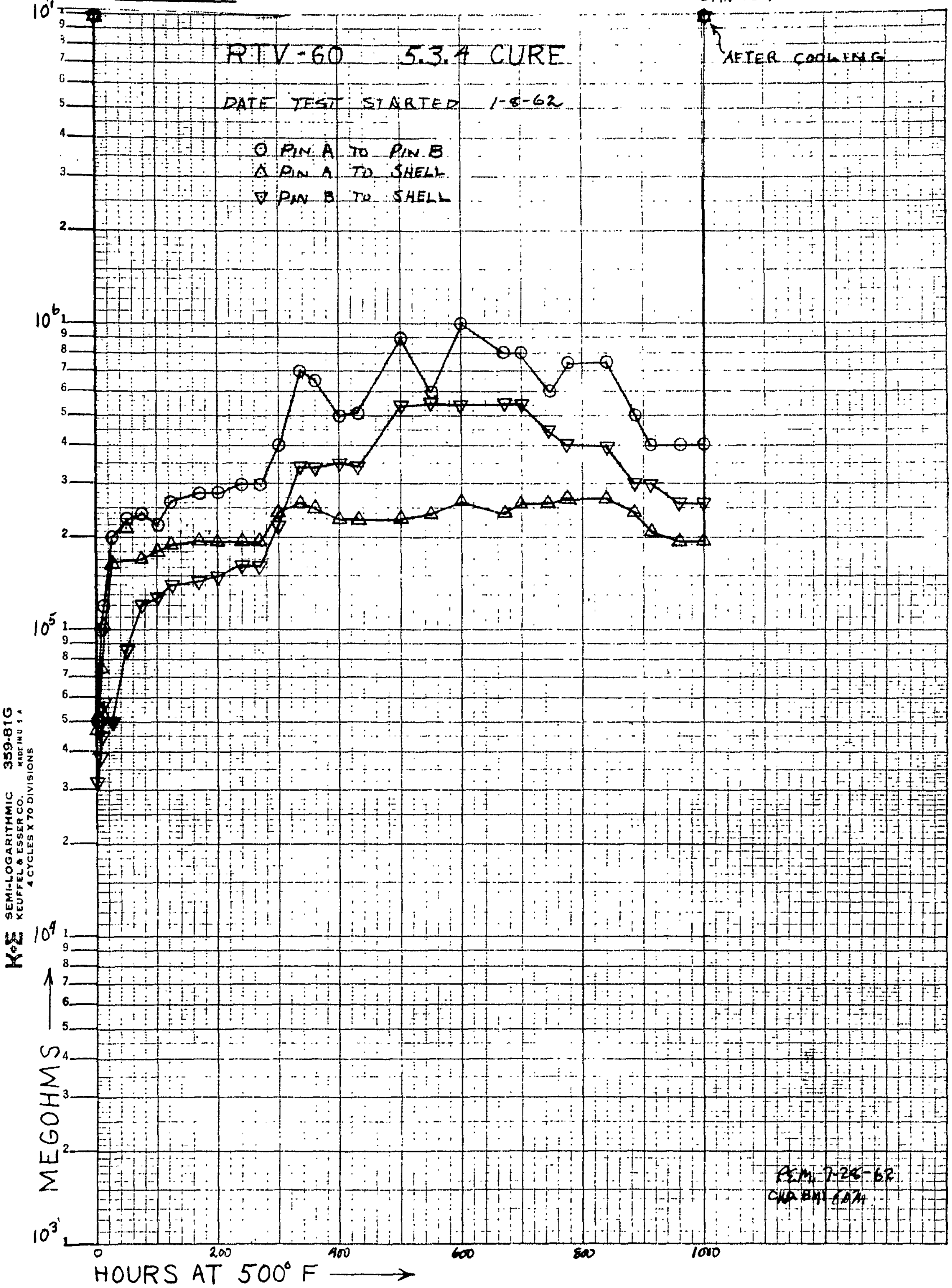
REM 7-27-62
CHP. BY: [illegible]

CANNON CONNECTOR



RM 7-24-62
CKD BY: ETAL

CANNON CONNECTOR



D U P L I C A T

TEST REQUEST

TITLE ELECTRICAL POTTING COMPOUNDS-SURFACE AND VOLUME RESISTIVITY AT ELEVATED TEMPERATURES FOR PROTRACTED TIMES

LABORATORY OR DEPT. RESPONSIBLE FOR TEST D253 Prime Responsibility	MODEL
Dept. 685 /s/ DB/EMP 4-21-61	Misc.
TEST PARTS ON IBM ☐: ON TPL NO. ______ PRODUCTION PARTS FOR TEST NOT REQUIRED ☒	APL/EPI None

WORK REQUESTED

OBJECTIVE (GIVE PURPOSE OF TEST, WORK AND DATA REQUIRED INCLUDING SERVICE HISTORY AND BACKGROUND INFORMATION)

REV. "A" Revised pages 2, 3, 5, & 6 and added page 3.1 to add test for 4 cannon connectors - See page 3.1

Rev. "B" Revised page 4 & 5 to extend 500°F life test to 1000 hours M/H added To perform Test

1.0 OBJECT:

To determine the electrical and physical properties of potting compounds that must be capable of continuous operation at elevated temperatures. F6575-018

Rev. C

2.0 HISTORY:

Recent observations of test specimens that included a potting compound ostensibly suitable for 300°F continuous service indicated that this rating may be in excess of true capability.

Rev E ADDS ACTUALS 10-17-62

3.0 JUSTIFICATION

Various communication, navigation, flight control, and weapons control systems employ electrical and electronic circuitry that must have high impedance separation of non-connecting circuits if proper operation is to be achieved. As a further requirement, in many cases, electrical connectors employed in these circuits must be able to provide this high impedance insulation while subjected to elevated temperatures for protracted periods of time. Since, at other periods of time, these same connectors must be moisture-proof, they must be sealed with a potting compound.

Rev "D" - 64 add'l M/hrs req'd to complete plotting & graphing of data (110 graphs) Appr. [illegible] Auth C. Kuna 8/13/62

4.0 MATERIALS:

4.1 Coast Pro-Seal 777 (from MAC stock)

4.2 Coast Pro-Seal 777P (primer from MAC stock)

4.3 Products Research PR-1525 (provided by Dept. 684)

REFERENCES OR ENCLOSURES

1. MAC P.S. 17171 (Rev.B)
2. MAC P.S. 17172 (Rev.B)
3. MAC P.S. 17311 (16 Nov. 60)
4. Product Research Technical Data Sheet "PR-1525" (Dec.60)
5. MIL-S-8516C
6. ASTM D676-59T

REV 'C' REVISED CHARGE NO AS PER MEMO MP 62-282

4.4 Products Research PR-1521 and PR-1522 Primers (provided by Department 684)

4.5 General Electric R.T.V.-60 (provided by Department 684)

4.6 Hughson Chemical Co. EK-B579-1 Primer (from MAC stock)

4.7 3M Co. EC-1663 (from MAC stock)

4.8 3M Co. EC-1694 Primer (from MAC Stock)

4.9 20 Gage MIL-W-16878 Type E (Teflon) Hook-up Wire

4.10 Bendix Pygmy (PT Series) Connectors - 8 Required (PT06CP-12-10P or (PT00CP-12-10S PT01

4.11 Cannon Connectors, CA3106HR-10SL-4S(4 required)

5.0 TEST SPECIMEN PREPARATION:

5.1 Make 54 "surface and volume resistivity" specimens per MIL-S-8516C, paragraph 4.7.3.4 except mix and cure the potting compound as follows:

5.1.1 Coast Pro-Seal 777 per MAC P.S. 17171 Revision "B" dated 22 November 1960. Make two sets of specimens (each set consisting of 3 specimens) with the following cures:

5.1.1.1 48 hours at room temperature and no oven cure (record room temperature). Total of 6 specimens required.

5.1.1.2 24 hours at room temperature followed by 4 hours at 180°F. Total of 6 specimens required.

5.1.1.3 No room temperature cure but 5½ hours at 180°F. Total of 6 specimens.

5.1.1.4 No room temperature cure but 5½ hours at 200°F. Total of 6 specimens.

5.1.2 Products Research PR-1525 per Products Research data sheet dated December 1960. Make two sets of specimens each with the following cures:

5.1.2.1 72 hours at room temperature and no oven cure. Record room temperature. Total of 6 specimens required.

5.1.2.2 No room temperature cure but 3 hours at 180°F. Total of 6 specimens required.

5.1.2.3 No room temperature cure but 16 hours at 180°F. Total of 6 specimens required.

CAUTION: DO NOT mix the A and B components of PR-1525 while they are above room temperature as the work life of the resulting compound will be drastically reduced.

5.1.3 3M Co. EC-1663 per MAC P.S. 17172 Revision "B" dated 9 May 1960. During the 24 hour room temperature cure that precedes the 10 hours at 180°F to 200°F oven cure, keep specimens in an area where the relative humidity is a minimum of 50% or preferably greater. Total of 6 specimens required.

5.1.4 General Electric RTV-60. Prepare a total of 6 specimens in the same manner as the 3M Co. EC-1663 shown in paragraph 5.1.3.

NOTE: Vacuum deaerate all potting compounds before making test specimens in paragraphs 5.1 and 5.2.

5.2 Eight connector specimens shall be made using Bendix Pygmy resilient insert (PT series) connectors and 20 gage MIL-W-16878 Type E (Teflon) hook-up wire. Tetra-etch the teflon wire per P.S. 17165 dated 23 August 1960 prior to installing in the connectors.

For the wire used with PR-1525, etch for 3 to 5 minutes. A total of 8 specimens will be required. Prime the wires and connectors and pot the connectors as follows:

5.2.1 For Pro-Seal 777 specimens, prime with Pro-Seal 777P and pot per P.S. 17171. Cure 5 1/2 hours at 180°F immediately after potting. Two specimens required.

5.2.2 For PR-1525 specimens, apply a thin coat of PR-1521 and allow it to air dry at room temperature for 30 minutes. Then apply a thin coat of PR-1522 and allow it to dry at room temperature for 30 minutes. Using techniques of P.S. 17171 pot with PR-1525 and cure at 180°F for 3 hours immediately after potting. Two specimens required.

5.2.3 For 3M Co. EC-1663 specimens; (a) Prime one specimen with 3M Co. EC-1694 per P.S. 17172. Be very careful to allow the primer to dry for a minimum of 2 hours at room temperature in an area where the relative humidity is at least 50%. After primer has dried, pot with 3M Co. EC-1663 per P.S. 17172. (b) Prime one specimen with Hughson Chemical Co. EX-B579-1 per P.S. 17311 dated 16 Nov. 1960. Clean the connector prior to priming per P.S. 17172, NOT PER P.S. 17311. After priming, pot with 3M Co. EC-1663 per P.S. 17172. A total of 2 3M Co. EC-1663 specimens are required.

5.2.4 For General Electric RTV-60 specimens: (a) prime one specimen with Hughson Chemical Co. EX-B579-1.Primer per P.S. 17311 dated 16 November 1960. Clean the connector prior to priming per P.S. 17172, NOT per P.S. 17311. After priming, pot with General Electric RTV-60 per P.S. 17172. (b) Prime one specimen with 3M Co. EC-1694 per P.S. 17172. Allow primer to air dry for a minimum of 2 hours at room temperature in an area where the relative humidity is at least 50%. After primer has dried, pot with General Electric RTV-60 using techniques and cure schedule of P.S. 17172. A total of 2 RTV-60 specimens are required.

5.3 Four connector specimens shall be made using the connectors listed in paragraph 4.11, the wire described in paragraph 5.2, and potting-primer combinations below.

5.3.1 One specimen same as 5.2.3 (a)

5.3.2 One specimen same as 5.2.3 (b)

5.3.3 One specimen same as 5.2.4 (a)

5.3.4 One specimen same as 5.2.4 (b)

6.0 TESTING PROCEDURE: **

6.1 Determine volume and surface resistivity in accordance with MIL-S-8516C paragraph 4.7.3.4 and as shown in Tables I and II. Perform the elevated temperature tests in a circulating-air-type oven. Suspend the specimens or support them on a wide grid wire mesh so air can circulate freely about them. Locate a thermocouple as close to the specimens as practical to determine actual specimen temperature. Test specimens in Table I shall be stabilized for one hour before determining resistance. Surface and volume resistivity shall be determined for each specimen at all temperatures and times shown in Table I and Table II.

**NOTE: All tests shown in Tables I and III shall be run before tests shown in Tables II and IV.

Rev A — Additional M/H required to perform changes to test scope as noted

K R Mills For C Fyfe
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POTTING MATERIAL	CURING METHOD	NO. OF SPECIMENS	TEST TEMPERATURES (°F)
-777	5.1.1.1	3	All of these specimens shall be tested at Room Temperature 100 - 150 - 200 - 250 - 300 - 350
-777	5.1.1.2	3	
-777	5.1.1.3	3	
-777	5.1.1.4	3	
PR-1525	5.1.2.1	3	
PR-1525	5.1.2.2	3	
PR-1525	5.1.2.3	3	
EC-1663	5.1.3	3	These specimens to be tested at Room Temperature - 100 - 200 - 300 - 400 - 500 - 600
G.E. RTV-60	5.1.4	3	

TABLE I

NOTE: Use different specimens for tests shown in Table I and Table II

POTTING MATERIAL	CURING METHOD	NO. OF SPECIMENS	TESTING TEMP.	TEST READING TIMES IN HOURS
-777	5.1.1.1	3	300°F	0.5 - 1.0 - 5.0 - 10 - 25 - 50 - 75 - 100 - 150 - 200 - 250 - 300
-777	5.1.1.2	3	300°F	
-777	5.1.1.3	3	300°F	
-777	5.1.1.4	3	300°F	
PR-1525	5.1.2.1	3	300°F	
PR-1525	5.1.2.2	3	300°F	
PR-1525	5.1.2.3	3	300°F	
EC-1663	5.1.3	3	500°F	0.5, 1.0, 5.0, 10, 25, 50, 75, 100, 150, 200, 250, 300, 350, 400, 450, 500, 550, 600, 650, 700, 750, 800, 850, 900, 950, 1000
G.E. RTV-60	5.1.4	3	500°F	

TABLE II

NOTE: Reading times shown in Table II may be varied slightly to fit in with laboratory shift schedule.

6.2 Measure typical contact-to-contact and contact-to-shell resistance of the potted electrical connector specimens under conditions shown in Table III and Table IV. Use different specimens for each type of test.

POTTING MATERIAL	CURING METHOD	NO. OF SPECIMENS	TEST TEMPERATURES (°F)
777	5.2.1	1	All specimens shall be tested at
PR-1525	5.2.2	1	Room Temperature - 100-150-200-250-
EC-1663	5.2.3 (a)	1	
EC-1663	5.2.3 (b)	1	300-350
G.E. RTV-60	5.2.4 (a)	1	
G.E. RTV-60	5.2.4 (b)	1	

TABLE III

POTTING MATERIAL	CURING METHOD	NO. OF SPECIMENS	TESTING TEMP.	TEST READING TIMES IN HOURS
777	5.2.1	1	300°F	0.5, 1.0, 5, 10, 25, 50, 75, 100, 150, 200, 250, 300
PR-1525	5.2.2	1	300°F	25 - 50 - 75 - 100 - 150 -
EC-1663	5.3.1	1	500°F	0.5, 1.0, 5, 10, 25, 50, 75,
EC-1663	5.3.2	1	500°F	100, 150, 200, 250, 300, 350,
G.E. RTV-60	5.3.3	1	500°F	400, 450, 500, 550, 600, 650,
G.E. RTV-60	5.3.4	1	500°F	700, 750, 800, 850, 900, 950, 1000

TABLE IV

7.0 DATA REQUIRED:

7.1 Record in the report for each specimen:

7.1.1 Manufacturer's batch number

7.1.2 "Use Before" or "Manufactured" date (both if available)

7.1.3 Whether taken from MAC production stock or newly supplied

7.1.4 Date specimens were made

7.1.5 Dates of all test

7.2 Color photos of volume and surface resistivity specimens both before and after tests.

7.3 Black and white photos of connector specimens both before and after tests.

7.4 Show results of durometer hardness measurements of specimens in accordance with ASTM D 676-59T both before and after tests (with specimens at room temperature).

7.5 Plot volume and surface resistivity versus temperature for each specimen of each material.

7.6 Plot volume and surface resistivity at elevated temperature versus time for each specimen of each material.

7.7 Plot contact-to-contact and contact-to-shell resistances versus temperature for each specimen of each material.

7.8 Plot contact-to-contact and contact-to-shell resistance at elevated temperatures versus time for each material.

7.9 Record any apparent deterioration of the potting compounds observed during or after the tests.

7.10 Record room temperatures in which measurements were made.

7.11 Record apparent adhesion of potting compounds to connectors and wire both before and after elevated temperature tests. This can be determined by slight flexing of potting and slight oscillation and rotation of wires relative to the potting.

8.0 SPECIMEN DISPOSITION:

At conclusion of tests, send all specimens to Department 684.